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Official Journal of the African Association of Thoracic and Cardio-Vascular Surgeons

EDITORIAL.

SURGERY FOR CARDIOVASCULAR DISEASE IN AFRICA.

Despite progress in the treatment of cardiovascular disease worldwide, the application of corrective surgery to the armamentarium available for treatment of patients presenting in the developing nations remain an infrequent occurrence. Notwithstanding the constraints imposed by infrastructural underdevelopment and dearth of financial support the medical specialist dedicated to the care of these patients continue to demonstrate that it is indeed possible to make the biblical "bricks without straws"!

The current issue of the Journal represents a compendium of publication attesting to the achievement of "respectable" outcomes of surgery in the medium of high risk deriving from non-medical factors.

The first paper, *"Long term follow-up of 226 patients with Heart valve prostheses"* by Ayegnon et al from the National Institute of Cardiology in Egypt demonstrates the outcome in a centre with "large volume" surgical experience with valve replacement. Unlike most other countries in Africa the majority of their patients (73%) presented in functional class II NYHA at time of surgery. They documented the negative impact of atrial fibrillation on long term survival of their patients, especially those with mitral prosthesis. Hopefully the modern surgical techniques now available for addressing atrial arrhythmias will improve future outcomes in these patients.

The second paper, *"Complications in adult cardiac surgery"* is a review by Pezzella from Worcester, Massachusetts. This excellent contribution is especially relevant as a template for Institutions at the inception of developing an Open Heart surgery programme. It emphasizes the need for structured protocols to enable early response to or prevention of anticipated complications. The next paper, *"Thrombolysis for prosthetic valve thrombosis: A report of 6 cases and review of the literature"*, comes from the group in Accra, Ghana and is a report of their experience with the use of thrombolytic drugs for treatment of thrombosed prosthetic heart valves. With an 83% success rate, they recommended the use of the drugs as first line management due to cost saving and safety.

The paper, by Ba et al from Dakar, entitled *"Reconstructive surgery for rheumatic mitral regurgitation in Children"* provides relevant information on mitral valve repair in a selected group of children. Despite the know difficulty with repair in such patients good results were recorded in 77% of cases. However the mean follow-up period of 67 days does not allow for a meaningful assessment of its contribution to valve surgery in these children.

Tettey et al from Accra, presents *a case report, of a patient with a retained ingested denture who developed tracheosophageal fistula that subsequently required a colon bypass after tracheal repair and oesophagectomy.* The dire consequences of failure to extract ingested objects lodged in the aero-digestive system is once again highlighted especially given that some may be intentionally so located in pursuit of "obscure" goals by the patient! Interestingly, the very next paper from Libreville, Gabon, by Mbamendame et al, is a *case report of a retained foreign body in the bronchus is a 9 year old child.* The subsequent pulmonary destruction necessitated bio-lobar resection and post-operative empyema; all preventable by early resort to trans-endoscopic extraction.

Ndiaye et al reports their experience with *surgical intervention for abdominal aortic aneurysms in Dakar.* Fifty percent of their cases presented with pulsatile abdominal mass and confirmation was obtained by ultrasonography in 13 of 16 cases; only 1 patient had the benefit of arteriography. Despite the limited facilities for evaluation of patients the medium outcome was favourable in 11 patients.

Diallo et al investigated *the incidence of venous thrombosis on their Cardiology services over a period of five years using Doppler for confirmation.* They document an incidence of .52%, with 56% female occurrence and a mean age of 51 years. Deep venous involvement was seen in 40% of the cases with pulmonary embolism in 12%. However, it is doubtful that all patients were detected given the poor diagnostic accuracy of clinical signs.

This issue of the Journal also includes *abstracts* from the cardiothoracic session hosted at the West African College of Surgeons Scientific meeting in Dakar, Senegal in February 2007.

We are indeed most grateful for all the contributors.

Prof Oluwole Adebo.

cardiaque. Avant l'intervention chirurgicale, les patients étaient en classe fonctionnelle NYHA II (7 3,5%) et NYHA III (26,5%) et l'ECG ne montrait pas de fibrillation auriculaire (FA). En postopératoire, deux groupes ont été constitués: Groupe I (patients en rythme sinusal) et Groupe II (patients présentant une fibrillation auriculaire).

La voie d'abord chirurgicale était la sternotomie médiane (10 0%). Les interventions ont été réalisées sous circulation extracorporelle standard réfrigérée entre 18 et 20 degrés Celsius. Une cardioplegie froide au potassium était réalisée chez 100% des patients. Les anneaux prothétiques ont été fixés par une suture en surjet (10,2 %) et par des points en U de Toupet séparés (89,8%). La durée moyenne du clampage aortique était de 72±6,1 minutes (extrêmes 40 et 180 minutes). Tous les patients ayant un pontage aortocoronaire concomitant (n = 3) ont été exclus de l'étude. Le délai médian d'hospitalisation était de 15 jours. La sortie a été autorisée sous traitement anticoagulant (Warfarine) à vie pour les prothèses mécaniques mitrales. Un traitement digitalique avait été administré dans 53% des cas pour contrôler la réponse ventriculaire et thrombolytique (acétyle salicylique 32%) respectivement sur une période de 40±7 jours et de 6±1,5 mois. Dans les suites opératoires immédiates, aucun choc électrique n'a été réalisé.

L'examen clinique de surveillance était mensuel la première année, trimestriel la deuxième année et annuel au- delà de la de 3,1±0,5 jours et 5±0,8 jours dans les groupes I et II. Le délai médian d'hospitalisation dans le service est de 15 jours et 17 jours respectivement chez les patients du groupe I et II. Le suivi est valable pour 226 patients avec une moyenne de 14 ans (4520 d'années patient). Le suivi médian est de 4750 années patient, avec des extrêmes de 12 et 20 ans (Tableau I).

Pendant le suivi 9,09 % (10/110) des patients du groupe I et 52,59% (61/116) des patients du groupe II sont décédés. La mortalité par double prothèses mécaniques et par prothèse mitrale était différente dans les deux groupes (P<0,05).

Durant la période de suivi externe, 28,32 % (n = 64) des porteurs de prothèses sont décédés. La mortalité tardive d'origine cardiaque est de 2,70 patients/année. Les causes cardiaques de décès étaient l'endocardite (1,41% vs 2, 82%), la coagulopathie (8,45 % vs 0%) , la thrombose prothétique (0% vs 23,9%), la cardiomyopathie (0% vs 45,07%) et un dysfonctionnement de la prothèse de Bjork-Shiley (1,41% vs 0%) respectivement dans le groupe I et II (Tableau II).

Tableau I : Résultats du suivi postopératoire tardif selon le rythme cardiaque.

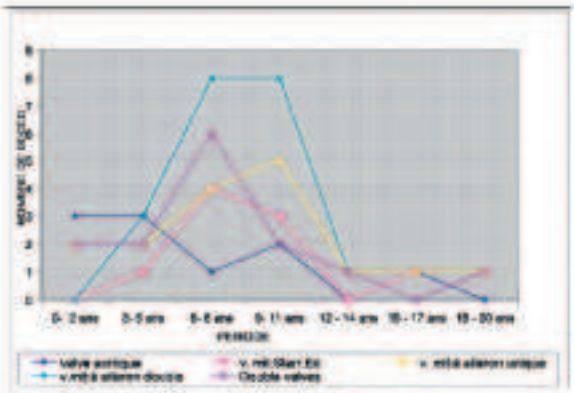
Type de prothèse		Rythme cardiaque				Total	
Valvulaires/ mécaniques		Groupe I		Groupe II		Décès	survivants
		Décès	survivants	Décès	survivants		
Aortiques (indéterminés)		10	58	0	0	10	58
Mitral	Starr-Edwards	0	7	10	6	10	13
	A aileron unique	0	8	16	8	16	16
	A aileron double	0	14	21	23	21	37
Double		0	13	14	18	14	31
Total		10	100	61	55	71	155

Tableau II : Causes de mortalité selon le type de la prothèse valvulaire mécanique.

Types de prothèses mécaniques	Causes de décès			Total
	Thrombose prothétique	Accident cérébro vasculaire	Dysfonctionnement de prothèse	
Aortique	0	0	1	1
Indéterminées - Starr-Edwards - A aileron	4 5	1 0	0 0	5 5
Mitrale - Unique - Double aileron	8 2	0 5	0 0	8 7
Total	15	6	1	24

(44,25%) , et 85,30% (11,76%) vs 46,02% (49,5 6%) dans les groupe I vs II (Fig 1) .

Fig. 1 : Décès des porteurs de prothèses pendant le suivi



Les 52,72% (n = 58) des patients du groupe I porteurs de prothèses mécaniques en position aortique ne présentent pas de signes cardiaques. Les porteurs de la prothèse mécanique en position mitrale 29% (n=29) vs 67,27% (n = 37) des survivants des groupes I et II sont au stade fonctionnel NYHA I vs NYHA II.

Parmi eux 40% de la classe fonctionnelle NYHA II sont porteurs de prothèse mécanique mitrale à aileron unique. Les porteurs de double prothèses valvulaires mécaniques 14% vs 32,37% des groupes I et II étaient respectivement au stade fonctionnelle NYHA I et en FA lente avec un diamètre moyen de l'oreillette gauche égale a 5± 0,2 cm. Dix huit patients survivants (7 du groupe I et 11 du groupe II) porteurs de prothèses mécaniques mitrales ont une anémie hémolytique chronique. Seize patients du groupe

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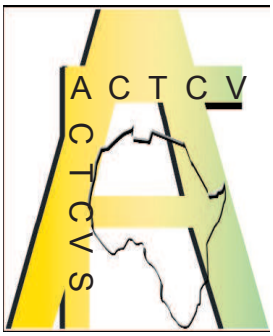

CHIRURGIE CARDIAQUE/CARDIAC SURGERY

COMPLICATIONS IN ADULT CARDIAC SURGERY - A GENERAL OVERVIEW.

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Summary

Cardiac Surgery has made significant advances over the past fifty years. Over 700,000 adult cardic operations are performed annually in the USA and more than 700,000 worldwide. Despite increasing age, complexity, and comorbidity, the results have continued to improve. This is due, in large measure, to the specific areas of improvement and experience in preoperative selection and prepar ation; operative advances, especially in monitoring, anesthesia, surgical skill, techniques and technology, cardiopulmonary bypass; and postoperative care, particularly in the intensive care environment. This review will focus on the general advances in the understanding of complications, risk assessment, quality assurance, and the emergence of evidence based medicine as a powerful tool to apply objective data to best practice medicine and prevention of mistakes, errors, near misses and complications.

Key Words: Adult Cardiac Surgery Complications-Mistakes-
Errors- Quality Assurance-Risk Assessment-
Evidence Based Medicine.

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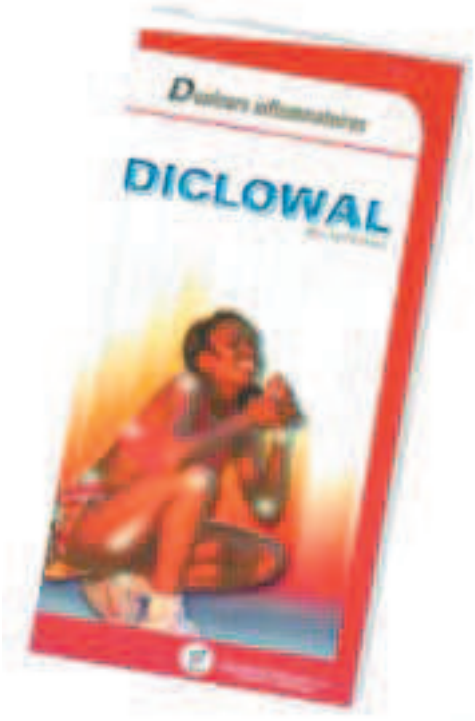
Introduction
Complications/Mortality
Strategic/Organizational Initiatives
Tactical/Managerial initiatives
Pre-operatoire phase
Risk Assessment/Severity Scores
Operative phase
Postoperative phase
Long term Result
Cost
Evidence based medecine
Quality Assurance/Quality Improvement

« I keep six honest serving-me (they taught me all i knew); Their names are What and Why and Hen and How and Where and Who»



Introduction

Cardiac surgery had its for mal beginni ng in the early 20th century. Ludwig Rehn was th first to successfully suture a penetrating wound of the heart in 1896, although Ansel Cappelen first cl osed a bleeding ventricular wound in 1894 with the postoperative death probably related to coronary injury and hemorrhagic shock[1]. Interestingly, it is not uncommon for unsuccessful «firsts» not to be accor ded the usual accolades befitting their accomplishments.?+ Subsequently, closed cardiac procedures evolved in the first half of the century , notably closure of patent ductus arterious, Blalock Taussig shunt, repair of coarctation, and closed approaches to the mitral and pulmonic valve[2]. Cardiac surgery utilizing cardiopulmonary bypass (CPB) dominated the second half of the 20th century, following a brief period of remarkable clinical series utilizing systemic hypothermia[3], or cross circulation approaches[4]. Since the first successful closure of an atrial septal defect (ASD) utilizing cardiopulmonary bypass (CBP) by John Gibbon at Jefferson University in Philadelphia, in 1953[5], the number of adult operations utilizing CPB has grown to a present annual rate of over 700,0 00 cases in the USA with the majority being coronary artery bypass grafting (CABG)[6] (figure 1). Worldwide the total number of procedur es utilizing CPB including both adult and pediatric populations is estimated at 1.2-1.4 million patients per year. Another 3,000 or more cardiac surgeons in another 1,000 centers complete the gl obal picture. Kirklin in 1990[7], summarized the previous 25 years in cardiac surgery to include technical and scientific advances in support systems, hospital environment, surgical procedures, myocardial management or protection, and the devel oping systems of comparison and prediction. This has burgeoned to include cost analysis, given the escalating costs (figure 1), risk stratification and management, outcomes and quality assurance. It is this latter concern that has dominated the literature in recent years. Relman stressed this in his concept of the three recent revolutions in medical care: 1950 -1970 as the era of expansion; 1971-19 85 as the revolt of payers; and 1986 to the present as the outcome movement[8].

This outcome movement has generated a whole new vocabulary ranging from risk to quality assurance, to outcome evaluation and analy sis, and ultimately quality of life issues. Unfortunately the language of advertising, marketing, providers, clients, product lines, networking and consortiums have also brought in to healthcare the whole aspect of medicine and heal th care deliv er y as a major business enterprise with costs and profits/losses on a parwith quality of care and medical outcomes. Public awareness and a perceived need for accountability has burgeoned into a major catalyst and driving force. The emergence of internet access and web based groups has spawned a large scale oveseeing of health care activity with subsequent unregulated reporting of outcomes and results.

Figure 1
Annual Caseload Open Heart Cardiac Surger y, USA*

Coronary Artery Bypass Graft (CABG) (2002)	515,000
Valve Replacement or Repair (2002)	93,00 0
Heart Transplantation (2003)	2,057
Congenital Heart (2000) (<20yrs of age)	25,00 0
Other (1999)[6]	90,00 0
Total	**7 25,057**

Estimated Direct and Indirect Costs of Heart Diseases

Estimated direct and indirect costs (in Billion of Dollars of heart diseases (United States : 2005)	**Heart di-seases**
Direct costs	
Hospital	$77,7
Nursing home	19,1
Physicians/Other professionals	18,5
Drugs/Other	
Medical durables	19,4
Home health care	4,8
Total Expenditures	**$139,5**
Indirect costs	
Lost productivity/Morbidity	21,4
Lost productivity/Mortality	93,9
Grand total	**$254,3**

* Heart Di sease and Stroke Statistics
- -200 5 Update, American Heart Association
(HYP ERLI NK «http://www.amer i canhear t.org» http://www.americanheart .org)

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Despite this scrutiny, increased knowledge, experience, maturity, judgment, technical advances, and improved skills have made open-heart surgery safer, efficient, cost effective, and more readily available, with subsequent decreases in

** Examples: John Streider at Massachusetts General Hospital ligated a patent ductus arteriosus in 1937 one year prior to Robert Gross. Clarence Dennis closed an atrial septal defect utilizing cardiopulmonary bypass in 1951, 2 years prior to John Gibbon. Both patients died perioperatively from complications.*
** Stephenson, L.W., Ch. 1 - History of Cardiac Surgery p3-29. In Cohn, L.H., Edmunds, H. ed. Cardiac Surgery in the Adult 2nd ed. Mc Graw-Hill, New York, 2003.*

overall mortality. At the national level , the Society of Thoracic Surgery (STS) National Cardiac Database reports a raw operative mortality for cardiac surgery in the USA of less than 5% with isolated CABG mortality under 3%[9]. *(www .ctsnet.org/doc/2988)* This has been corroborated at the regional, state, Veteran's Administration (VA) and institutionall evels. Representative in stitutional experiences are summarized in (figure 2 a, b) .

Figure 2 (a) : Toronto General Hospital Experience * Operations performed from 1993-1997

	Number	Meaning age (mean ± S.D.)	Urgent	Timing emergent	Mortality rate
Coronory Artery bypass	7371	62 10	44 %	3 %	2.3 %
Aortic valve surgery	1070	63 15	32 %	2 %	2.5 %
Mitral valve surgery	704	59 14	27 %	6 %	4.3 %
Double/triple valve surgery	381	57 16	23 %	3 %	9.0 %
Ascending aorta ± arch ± aortic valve surgery	475	57 16	26 %	16 %	6.6 %
Congenital heart surgery in adults	473	42 15	11 %	1 %	3.2 %
Miscellaneous	638	57 14	33 %	23 %	10.2 %

**Left ventricular aneurysms(254), heart transplantation (99), myectomy (94), mapping +ablation (44), post infarction rupture of the septum (37), atrial myxoma (29), others (82).*
** Adapted from Cheng DC, David TE. Peri operative care in cardiac anesthesia and surgery. Landes Bioscience Georgetown, TX 1999, p2*

Figure 2 (b) : Cleveland clinic 2002

	Mortality
CABG	1.2 %
Aortic valve surgery	< 1 % (repair) (0 % replacement)
Mitral valve surgery	0.3 %
Great vessel surgery	3.5 %

**Cleveland Clinic Department of Thoracic and Cardiovascular Surgery, 2002 Department Review (HYPERLINK «http://clevelandclinic.org/heartcenter» http://clevelandclinic.org/heartcenter)*

Figure 3 (a)[9] :

	Complications (%)	Mortality (%)
Re-operation for bleeding	2.32	13
Perioperative myocardial infarction	1.08	19
Infection – sternum – superficial	0.73	--
Infection – sternum – deep	0.63	11
Infection – Leg	1.26	--
Infection – UTI	1.52	--
Septicemia	0.9	38.6
Neurologic–CVA – permanent	1.65	28
CVA – transient	0.74	--
Delirium	2.62	--
Pulmonary–mechanical ventilation > 5 days	5.46	21
Pulmonary embolism	0.33	--
Pulmonary edema	2.12	--
ARDS	0.87	--
Pneumonia	2.45	--
Renal failure (creatinine>2.0)	3.14	30.6
With dialysis	0.87	47.6
Cardiac		
Heart block requiring pacemaker	0.81	--
Tamponade	0.39	25
Atrial fibrillation	19.37	--
Cardiac arrest	1.46	64.1
GI complication	2.45	17
Multisystem Failure	0.6	74.4

**http://www.ctsnet.org/doc/2988 (current specific complication rates after 1997 unavailable)*
+ Through 1997, 450 centers contribute patients to the STS-NCD 2.4 million patients through 1997 enrolled in STS-NCD. Data fields include 217 core fields and 255 extended fields Data analysis and warehouse center after 1998 at Duke clinical Research Institute
+ (Shahian, D.M, Blackstone, E.H.,Edwards, FH, et al. Cardiac Surgery Risk Models: A position article. Ann Thorac Surg 2004; 78:1868-1877)
944 of 4, 856 acute care hospitals in USA perform open heart surgery (Hospital statistics - 2002 Health Forum LLL, p159)

Figure 3 (b) : Toranto General hospital Experience

Complications rates from 1993-1997				
	CABG	Valves	AA/A	CHD
Miscellaneous	1.5%	4.0%	6.5%	4.2 %
Re-exploration for bleeding (4.2 %)	1.5 %	4.0 %	6.5 %	4.2 %
Perioperative stroke 2.2%	1.4%	2.5%	6.6%	0.0%
Perioperative myocardial infarction (0.6%)	2.4 %	1.3 %	1.7 %	0.6 %
Deep sternal infection 0.2%	0.8 %	0.7 %	1.1 %	0.6 %
Superficial wound infection 1.4%	1.7 %	0.8 %	1.7 %	1.9 %
Sternal dehiscence 0.2%	0.3 %	0.1 %	0.6 %	0.0 %
Renal failure 1.6%	0.3 %	0.3 %	0.6 %	0.0 %
Mean ICU stay (days) 3.4	1.9 %	2.5 %	3.3 %	2.4 %

Abbreviations CABG = coronary artery bypass graft; AA/A = ascending aorta + / - arch; CHD = congenital heart disease
** Adapted from Cheng DC, David TE. Perioperative care in cardiac anesthesia and surgery. Landes Bioscience Georgetown, TX 1999, p2*

This has gradually increased with changing demographics (age, sex, body surface area, body mass index), complex cardiac pathology with decreased left ventricular (LV) function, and increasing associated comorbidy.
This has led to subsequent increased lengths of stay (LOS),

organ fail ure, transfers to chronic health facilities, and increasing readmission rates. (Table 1)
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Table I : Risk factors associated with either increased length of stay (L) or Increased incidence of organ failure
Morbidity (M) or Both (L/M) Following coronary Revascularization.

Risk factor	Boston (10)	Albany (11)	V A (12)	Canada (13)
Demographics				
Advanced age	L		M	L
Increased ratio of age/red blood cell volume		LM		
Female gender				L
Disease specific diagnoses				
CHF or cardiomegaly	L	LM	M	
Concomitant valve disease			M	L
Reoperation			M	L
LV dysfunction (ejection fraction)				L
Surgical priority			M	L
IABP pre-op	L			
Active endocarditis			M	
Comorbid conditions				
Obesity	L			
Renal dysfunction	L	L		M
Peripheral vascular disease		L		M
Chronic obstructive lung disease		L		
Cerebrovascular disease		L/M		
Hypertension		L/M		

Abbreviations: CHF= congestive heart failure; LV = left ventricular; IABP = intraaortic balloon counterpulsation

In short, higher risk patients are surviving with attendant increases in morbidity, yet ultimate increase in survival, albeit with long term quali ty of life issues and challenges. Preoperative selection and preparation, diagnostic sophistication, improved and advanced operative approaches and technique, and advances in the intensive care unit (ICU) have contributed to this continued effort. Better knowledge of the pathophysiology of the disease process, advanced monitoring, and improved and more effective medications, especially anesthetic agents, have dramatically stabilized and improved the perioperative care of patients. Improved diagnostic support, especially at the bedside, along with increasing electronic interface, bedside computerized nursing, and more reliable point of care testing are becoming valuable components of the standartized critical pathways. ?? The application of risk analysis, best practice or evidence based medicine (EBM), along with emerging guidelines and algorythms will continue to help cardiac surgeons give better care to their patients and help avoid or decrease untowards results, i.e. complications, in this increasing group of challenging patients.

Complications

Against this background of advances in cardiac surgery with higher risk groups is the increased focus on quality assurance, outcomes and costs, along with the stress and agony of poor results or complications. Traditionally it is the cardiac surgeon who, as the head of the team, is perceived as the most culpable or responsible for untoward results. Surgeons have been most mindful of this accountability and responsibility. It has been the careful analysis of complications with emphasis on prediction, avoidance, recognition and treatment through the medium of the traditional morbidity /mortality conferences (M&M) that has advanced the quality of surgery in the USA and worldwi de through the years. The report of the Institute of Medicine, «To Error is Human», focused national attention on the potentially harmful effects of human error in medicine, noting 44,000 to 98,000 deaths occurring annually due to medical errors[14]. The incidence of iatrogenic deaths and society cost from all causes may be even higher (Table 2).

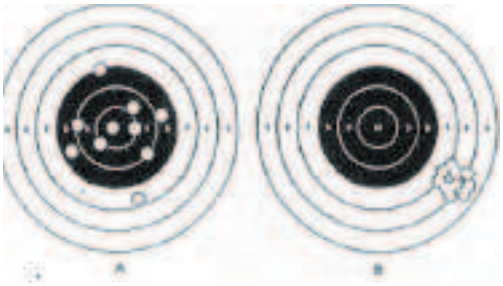
Table 2 : Iatrogenic Deaths in the United States*

Iatrogenic Deaths in The United States (Deaths induced inadvertently by a physician or surgeon or by medical treatment or diagnostic procedures)		
Condition Deaths	**Deaths**	**Costs**
Adverse Drug Reactions	106,000	$12 billion
Medical error	98,000	$2 billion
Bedsores	115,000	$55 billion
Infection	88,000	$5 billion
Malnutrition	108,800	------
Outpatients	199,000	$77 billion
Unnecessary Procedures	37,136	$122 billion
Surgery-Related	32,000	$9 billion
TOTAL	7 83, 93	$ 282 billlion
* *(http://www.ourciviliztion.com/medicine/usamed/deaths.htm)*		

The public and press, especially with the burgeoning internet access have demanded increased knowledge and information re. outcomes and results (Table 3, 4). The bottom line is the perception, or, in fact, the reality that safety and quality are of major concern to the general public. A detailed analysis of complications is thus warranted to help us better predict, prevent, recognize, and treat complications.
Three aspects of untoward results or complications need

"Critical pathways, also known as critical paths, clinical pathways, or care paths, are management plans that display goals for patients and pro - vide the sequence and timing of actions necessary to achieve these goals with optimal efficiency." Every, N.R., Hochman, J., Becker, R., Kopecky, S. Cannon, C.P. AHA Scientific statement ; Critical pathways - A review circulation 2000;101:461-470

to be examined : human factors, errors and complications. Carthey et al[15] have summarized nicely the aspects of the human factor in cardiac surgery. They utilized the concepts of institutional and individual differences in surgical performance. This is based on the organizational accident causation theor ies of Reason[16]. These theories distinguish between active failures and latent conditions. Active failures are made at the scene, e.g. during surgery, whereas latent conditions are poor or inaccurate decisions made at higher levels, e.g., the manufacturers of product. In a detailed study of human factors in a multicenter study of 243 arterial switch operations for transposition of the great vessels, de Leval et al[17] highlighted the role of human factors in negative surgical outcomes. The negative outcome is accentuated by the patients' risk factors. Human compensation, i.e. recovery or rescue methods, are utilized to address both the error and risk factor. Human errors are normal in the sense that they occur . These errors result from inadequate, flawed, or illogical knowledge or behavior patterns. Reason[16] subsequently distinguishes variable and constant errors (Figure 4).



Target patterns of ten shots fired by two riflemen. As pattern exhibits no constant error, but rather large variable errors. B's pattern shows a large constant error, but small variable errors[17].

Clearly target B is constant and more easily corrected with a change in the rifle sight. This has dramatic application in the clinical setting where correcting an individuals performance is much easier than analysis and correction of a systems failure. Reason[16] nicely defines errors, mistakes, slips, and lapses.

« Error will be taken as a generic term to encompass all those occasions in which a planned sequence of mental or physical activities fails to achieve its intended outcome, and when these failures cannot be attributed to the intervention of some chance agency.»

« Mistakes may be defined as deficiencies or failures in the judgmental and/or inferential processes involved in the selection of an objective or in the specifications of the means to achieve it, irrespective of whether or not the actions directed by this decision-scheme run according to plan.» Slip is failure in execution of an intended action sequence[18]. Lapse is failure in the storage or memory phase of an action sequence[18].

Complications are thus the result of one of more of the four. Slips and lapses are active errors, whereas, mistakes are latent errors. A complication is thus a deviation or departure from the expected or anticipated outcome of a surgical procedure. Morbidity is a diseased condition or state that results from complications. This is a more generic term that includes the entire panorama or complications associated with cardiac surgery. Complications can be anticipated/ unanticipated, expected/unexpected, predicted/unpredicted, avoidable/unavoidable, or recognized/unrecognized. They can be temporally classified as preoperative, operative, or postoperative complications. Post-operative complications are further divided into early (<30 days) or late (>30 days) with chronic complications, residua, or deciduas being temporary (eg. phrenic nerve paraparesis) or fixed (e.g. CVA). Mortality is defined by The Society of Thoracic Surgery and The American Association for Thoracic Surgery as :

« Thirty-day mortality (sometimes termed operative mortality) is death within 30 days of operation. Hospital mortality is death within any time interval after operation if the patient is not discharged from the hospital. Hospital to hospital transfer is not considered discharge; transfer to a nursing home or rehabilitation unit is considered hospital discharge unless the patient subsequently dies of complications of the operation[19]».

Strategic/organizational Iniatives

Historically, postoperati e complications have been well addressed by the surgical community. In the early 1900's Ernest A. Codman classified complications as errors due to lack of technical knowledge or skill, surgical judgment, care, equipment or diagnostic skill[20]. It was also Codman who first championed the need for outcomes assessment[21]. Even earlier, Florence Nightingale, a devoted English nurse, noted disparity in outcomes in many London hospitals of the mid 1800's. She highlighted the concept of severity of di sease and risk adjustment[21]. She emphasized the concept that the hospital should do the sick no harm (*primum non nocere*).

The cornerstone of the approach to complications or adverse outcomes has been with the development of the American surgical training programs. The time honored surgical morbidity and mortality conferences (M&M's) are the origin and main stay of present day peer review and outcomes analysis. This all evolved with the departure of the American Halstedian surgical training programs from the European model of total proctored training. This American model of surgical resident included planning the operation, performing it, and providing the postoperative care, all in a structured, supervised way, with graduating degrees of super vision and autonomy[22]. Analysis of problems or complications was an integral component of this processed learning.

This program became the model for subsequent specialty programs (American Board of Specialties), and the ultimate establishment of the American Board of Thoracic Surgery in 1948[23]. This Halstedian tradition has been maintained with the structured system of progressive training, phased transfer or delegation of responsibility, and evaluation of surgical results and outcomes. Frank Spencer, a disciple of the Halsted/Blalock School, stated that 75% of the important

events in an operation are related to making decisions, and 25% to dexterity (Figures 5a, b)[24].

Figure 5 (a)[24] : Characteristics o f surgical decisions

1. Decisions are a combination of planning, observation, and deduction.
2. Two components
   - A. A precise plan
   - B. Modify the plan with unexpected events
3. Emotional considerations
   - A. Decisions under stress, within limited time "Balan cing probabilities" (Dunphy)
   - B. Few things in an operating room are neutral : either help or harm the operation

C. A calm, serious atmosphere with intense concentration (a conductor and a symphony orchestra)

Figure 5 (b)[24] : Four basic concepts about dexterity

1. Teaching is badly neglected
   - a. Importance minimized
     - i. "Teach a monkey to operate"
     - ii. "Will automatically learn"
   - b. Don't know how
   - c. Time consuming
2. A significant percentage of surgical complications are "error in technique"
3. Residents vary widely in natural ability, often those with little dexterity are taught "least".
4. Learning how to operate is a process that should continue for decades. The residency should teach one how to learn on his own.

Here again, the emphasis was placed on the individual surgeon, and not the system.

Both Frank Spencer and John Kirklin focused on the operating room environment. The atmosphere in the OR was serious, professional, calm, organized, and methodical. There was no wasted moves/motions or conversations (idle palaver). Concentration on the task at hand was the order of the day. Recent technology has added objective to subjective validation of these concepts. Tried and true aphorisms from our mentors still hold true - *«Cut well, tie well, get well»; « Modify, simplify, apply»; «Keep it simple»* - Denton A Cooley.

Unfortunately, the morbidity/mortality conference, as traditionally described, primarily addresses factual data, and offers limit ed insight into all aspects of complications. The discussi on oftentimes failed to balance punitive with constructive criticism. (Figure 6)

Figure 6 : Problems with Morbidity/Mortality Conference

- Presentation of chronological difficult cases, complications, deaths without tracking trends.
- Anecdotal without national statistical norms
- Narrow focus; ignores systems analysis
- Required by hospital or program; Hesitancy to be judgmental or punitive.

At a higher level discussion of trends and sentinel efforts affords deeper insight in to team function, product lines, critical care pathways, and systems analysis. Again the theories of Reason[16], as promulgated by de Leval and others[17], continue to stress the human failures or active errors and system or latent failure concepts. The broader concept of surgical failure also includes the notions of omission a nd commission. This implies things done or not done. Not to do an operation (omission), when indicated, can create a complication that is avoidable. In contrast, an operation done without absolute or relative indications (commission), can also cause complications that are unavoidable. De Laval continues to drive home the message of the Bristol affair. In his address «Beyond Flatland» he describes Flatland, a race of two dimensional people who are unable to appreciate the full reality of the Spaceland, or three dimensional universe[25]. Now we are in Complexland, a new wave of thinking resulting from the 1944 discovery of nonequilibrium thermodynamics. This implies self organization, whereby space and time patterns emerge at random without external influence. Again he is striving to emphasize methods to analyze complex problems. A note of caution here is not to add complex solutions to complex problems. Seek simplicity, then distrust, may be an appropriate approach. De Leval[17], in a simplified organized fashion analyzes medical outcomes resulting from the interaction of three sets of complex variables patients, treatment, and care providers. It is the care providers that constitute the human factor. Emphasis on error prevention, detection, and recovery ar e the logical areas of concentration in the detection and analysis of errors, or near misses. Error recovery is a crucial area, since it requires fairness and tolerance. Errors will occur and many are unpreventable. The ability to recover a serious unavoidable error or complication is the hall mark of a successful strategy for patient safety. Four isolated or combined factors will cause an airplane crash – weather, mechanical failure, human error, or a violent human action i.e. terrorism. All of these factors have been addressed in the airline industry, thus achieving the 2nd safest form of travel, after «escalators».

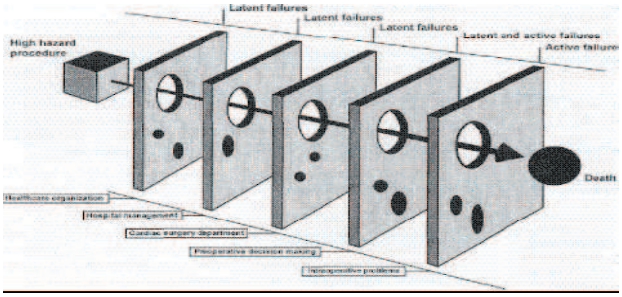
The Law of Parsimony may apply here, as fashioned from William of Occam's Razor theory, which is to look for simple solutions within a complex mileu. Humans are parsimony machines: they select the shortest and thus most efficient path to the production of true theorems, given a set of facts (observations) and theories *(HYPERLINK «http://www. knowledge-finder.c om/philosophy/parsimony-fourth-substance.html «www.knowledge-finder.com/philosophy/* parsimony-fourth - substance.html).

Blackstone[26] carries this further by nicely offering his statistical expertise to help us better utilize statistical data mechanisms in this analysis and assessment of outcomes. Employing a Newtonian concept, one should abandon traditional methods of logic, deduction, expert opinion (ie. «in my experience»), consensus, and let actual data

speak for themselves. This type of approach is called inductive logic, where analysis of the data infers information regarding the problem, or question, or hypothesis being considered. Blackstone[27] in a well reasoned editorial again emphasizes the Reason methodology in commenting on a series of articles devoted to monitoring of clinical performance[28,29,30].

The common cause variation in outcome analysis focuses on the «blunt end» i e. systems failure, whereas special cause variation is «sharp end» variation i.e. extrinsic influ ence (eg surgical skill or judgment).

Sundt, et al [31] has beautifully built on the Reason, de Leval and Blackstone approach. He utilizes the tools and methods described herein to focus on patient safety, ie. avoidance of problems through the understanding of the systems involv ed. This is adequately summarized in (Figure 7).



In Reason's[17] «Swiss cheese» model of accident causation, adverse events occur when active failures at the operational level align with gaps or weaknesses in the systems, or latent failures at the organizational level permitting an error or accident sequence to go untrapped and uncompensated. Efforts must be made to reduce the gaps as well as reduce the errors. The defense systems can fail either because of or organizational failure or because of performance failures of the operators. (Adapted from Carthley J, et al. The human factor in cardiac surgery: errors and near misses in a high technology medical domain. Ann Thorac Surg 2001; 72:300-5.)(16)

The concept of systems is an important one. Systems analysis is a common practice in the non-medical world. Systems analysis or improvement is synonymous with continuous quality improvement (CQI) or total quality management (TQM). W. Edwards Deming and J. M. Juran are the architects of this movement[32]. Following World War they dramatically helped re-establish and re-form Japan's manufacturing base. Deming established 14 points of management (Figure 8).

within a system of profound knowledge :

- knowledge of a system
- Knowledge of variation
- Knowledge of psychology
- Theory of knowledge

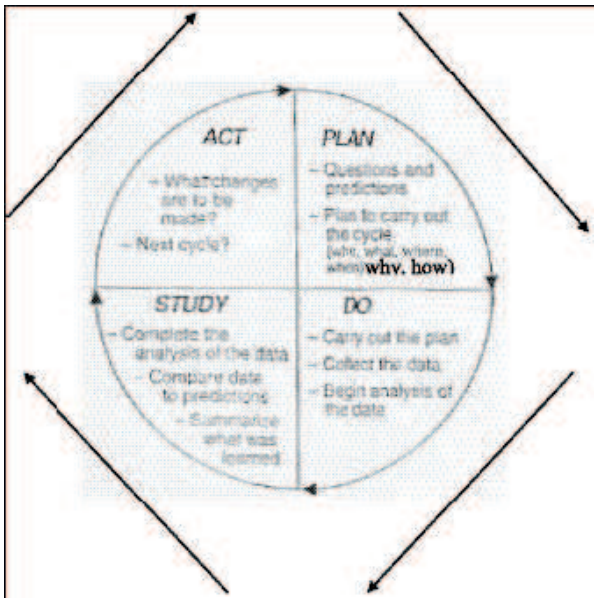
Noland[33] combiend this Deming improvement knowledge and professional health care nowledge into a PDSA (Plan-Do-Study-Act) cycle (figure 9)

Figure 8 : Demin's 14 Points for Management*

1. Create constancy of purpose for improvement of product and service.
2. Adopt the new philosophy.
3. Cease dependence on mass inspection.
4. End the practice of awarding business on the basis of price tag alone.
5. Improve constantly and forever the system of production
6. Institute training.
7. Adopt and institute leadership.
8. Drive out fear.
9. Break down barriers among staff areas.
10. Eliminate slogans, exhortations, and targets for the work force.
11. Eliminate numerical quotas for the work force and numerical goals for people in management.
12. Remove barriers that rob people of pride of workmanship.
13. Encourage education and self-improvement for everyone.
14. Take action to accomplish the transformation.

*(32) *Adapted from Scherkenbach WW: The Deming Route to Quality and Productivity. Milwaukee, ASQC Quality Press, 1986*

figure 9 : The PDSA cycle for learning and improvement[33]



A practical example of system anal ysis is the failure made effect analysis (FMEA) process developed by the military . The objective of FMEA is to identify failures or improvements in a product or process, as well as individual operator mistakes or errors. An example of its application is the evaluation of extracorporeal perfusion circuits[34]. A rating scale was developed to evaluate the degree of failure, the occurrence or incidence of failure, and the means of detection of failure. This highlights the concept that once recognized, failure of process or device can be corrected, improved, or replaced, thus avoiding adverse results.

There are very few classification systems available for

recording or documenting complications. Most texts and reviews list the major and minor complications associated with various procedures and operations. A generic classification system has been adapted from Rutherford[35] and Clavien[36]. (Figure 10)

Figure 10 : Surgical Complications

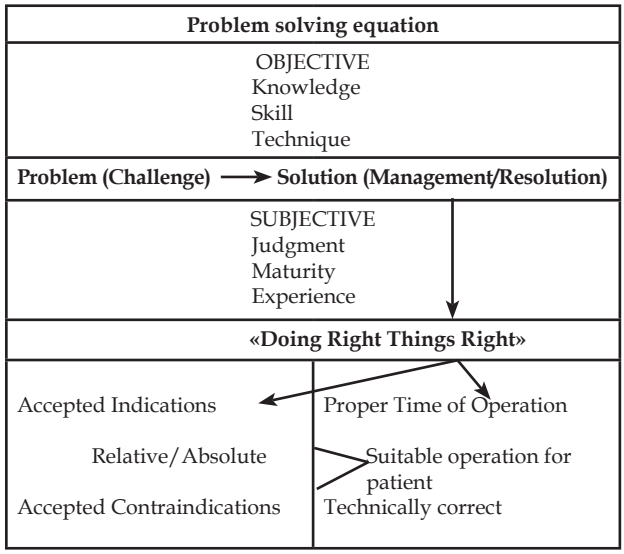
Classification schemes Types of complication	
Anticipated/Unanticipated Expected/Unexpected Predicted/Unpredicted Avoidable/ Unavoidable Recognized/ Unrecognized Preventable/ Unpreventable	- Fatal/Nonfatal (mortality/ morbidity) - Early/Late (<30 days/>30 days)? - Major/Minor - Permanent/Temporary - Disabling/Nondisabling - Specific/Nonspecific - Single/Multiple - Systemic/Local - Cardiac/Noncardiac
Categor y	
- Comorbidity factors – patient related - Systems failure - Directly attributable to operation (commission) – Human Factor - Directly attributable to delayed or premature operation or management, omission of operation, or failure to recognize error/complication - Unrelated to operation/procedure - Sequela*	
Outcome	
- Complete recovery/resolution from complication - Partial recovery - No recovery - Fatal	
Grading	
Grade I - Minor - resolved spontaneously without care, or patient care, or minimal medical care Grade II - Potentially - life threatening requiring intervention Grade III - Residual or lasting disability Grade IV - Death directly related to complication	

**Sequela (ae) accepted negative consequence of an operation or procedure eg surgical scar, decreased pulmonary function following lung resection, or decreased mobility following lower leg amputation.*
(35) Rutherford, R.B. Suggested Standards for reporting complications in Vascular Surgery p1-10. Complications in Vascular Surgery Bernhard, VM, Towne, JB ed Quality Med. Pub, St. Louis, 1991
(36) Clavien, PA, Sanabria, JR, Strasberg, SM. Proposed classification of complications of surgery with examples of utility in cholecystectomy Surgery 1992; 111:518-526.
**Early - One-time events - occuring within 30 days of surgery or before hospital discharge, whichever is sooner.*
Late - time-related events - after 30 days.
**Grunkemeier, G, Jin, R. Ch7-Surgical Treatment of Outcome Data p225-231. In Cohn, L.H., Edmunds, L.H., ed. Cardiac Surgery in the Adult 2nd edition, MC Graw Hill, New York, 2003.*

Tactical/Managerial/Initiatives

Given this broad based background of complications that attempts to give structure to the surgical process, let us now focus on specific efforts and initiatives to both understand and improve the process. Interestingly, cardiac surgeons perform operations and care for patients. Yet, all of this revolves around problem solving (Figure 11).

Figure 11 :



The subjective and objective elements involve a lifelong career of study and reflection beyond the formative training years. This is the role for the continuing medical education (CME) process. This includes conferences, meetings, seminars, workshops, symposia and personal interaction with colleagues. The internet has become a powerful tool in this endeavor *(www.ctsnet.org)*. A word of caution regarding experience. When tested and challenged with thoughtful study and reflection and appropriate changes and modifications experience is a most powerful tool. However, when not used properly and effectively, it can be extremely harmful. To quote Oscar Wilde «Experience is the name everyone gives to their mistakes». An experience with 100 operations could be one operation done wrong or improperly 100 times.

The establishment of standard guidelines, algorithms, local practice and clinical care pathways, are extremely useful and informative. Examples include practice guidelines developed by the Society of Thoracic Surgery[37] (Figure 12)

Figure 12 : Example of Surgical Practice Guidelines

ISCHEMIC HEART DISEASE: III[37]		
Diagnosis:	414.10	Left ventricular aneurysm
Procedure: ventricular aneurysm	33542	Resection or application
Indication:	1 2 3 4	Congestive heart failure Systemic emboli Angina pectoris Ventricular arrhythmias
Confirmation of Indication:		Cardiac imaging study with contrast, echocardiography, or radionuclide technique showing dyskinesia
Relative Contraindications		Asymptomatic true aneurysm
Actions Prior to Procedure:	1 2	Coronary arteriography Left ventriculography often indicated
Actions During Procedure:	1. 2	Remove mural thrombus In presence of ventricular tachycardia, map endocardium and ablate sites of early repolarization
Actions Following Procedure:	1 2	Cardiorespiratory support Treat arrhythmias
Outcome:	1 2	Mortality of 3% to 30% determined by patient age, general status, associated disease, and extent of myocardium involved. Discharge in 7 to 21 days
depending on preoperative status		
	3	Diminution or relief of symptoms

References

Komeda M, David TE, Malik A, Invanov J, Sun Z. Operative Risk and Long Term Results of Operation for Left Ventricular Aneurysm. Ann Thorac Surg 1992; 53:22-29.

Mills NL, Everson CT, Hockmuth DR. Technical Advances in the Treatment of Left Ventricular Aneurysm. Ann Thorac Surg 1993;55:792-800.

Baciewicz PA, Weintraub WS, Jones EL, et al. Late Follow-up after Repair of Left Ventricular Aneurysm and (usually) associated Coronary Bypass Grafting. Am J Cardiol 1991:68:193-200.

as well as the American Heart Association/American College of Cardiology (AHA/ACC) recommendations or guidelines, series (*www.acc.org/clinical/statements.htm*). However, they do not replace the time honored individualized approach to patient care. The paradigm shift to focus on the total patient in a holistic fashion as the basis of care has dominated the current scene[38]. The Cardiothoracic surgeon may delegate responsibility of care of his patient to appropriate consultants or services (e.g. Intensivists) but he/she remains totally involved in the short and long term care.

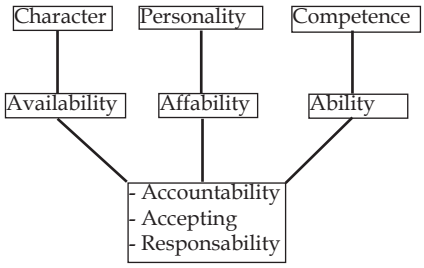
Familiarity with proper diagnosis and coding are extremely important. It is these codes that form the basis for data retrieval and billing. Improper documentation can become the source of inaccurate database information and billing submissions, especially in an unaudited atmosphere. The International Classification of Disease, Ninth Revision, and Clinical Modification (ICD-9- CM) classifies morbidity and mortality information for statistical purposes, as well as indexing of hospital records by disease and operations [39]. It is important to distinguish complications of care from preexisting co-morbidities. The coding is also limited by the inability to document the temporal relationships of preoperative and postoperative conditions or complication. The Current Procedural Terminology (CPT) is a listing of descriptive terms and identify ing codes for medical services and procedures performed by physicians[40]. Most of the data utilized by overseeing groups, like Leapfrog, and Medicare eminate from these sources. The Society of Thoracic Surgery and the American Association of Thoracic Surgery have been very proactive in educational aspects of CPT and I CD- 9- CM codi ng. (HYPERLINK *« http://www.ctsnet.org/doc/319» http://www. ctsnet. org/doc/319*).

The residency training period has undergone recent modification both in length, operative requirements, and quality. The American Cardiothoracic Residency program is evolving in to a six year program with 3 years basic surgery, and 3 years specialty training. Competence has become a focal point for all graduate medical education programs. The Accreditation Council for Graduate Medical Education (ACGME) has endorsed six areas of general competencies to be incorporated in to the GME programs. Ultimately, the successful surgeon must have 3 attributes : Character, Personality and Competence (figure 13)

Figure 12 : Areas of general ACGME competency

Category	ACGME competency
Patient care	Residents must be able to provide patient care that is compassionate, appropiate, and effective for the treatment of health problems and promotion of health
Medical knowledge	Residents must demonstrate knowledge about established and evolvir biomedical, clinical, and cognate (eg, epidemiological and socio-behavioral) sciences and the application of the knowledge to patient
Practice-based learning and improvment	Residents must be able to investigate and evaluate their patient care apraise and assimilate scientific evidence, and improve their patient pratices
Interpersonal ans communications skills	Residents must be able to demonstrate interpersonal and communicative skills that result in effective information exchange and teaming with patients, patients' families, and profesional associates
Profesionalism	Residents must be demonstrate a commitment to carrying out profesional responsabilities, adherence to ethical principles, and sensitivity to a patient population
System-based practice	Residents must demonstrate an awarness of and responsiveness to the contxt and system of health care and the to call on system to provide care that is of optimal value

Figure 13[41] : Competence Personality



Kwasnik[42] has added a fourth "A"- Accountability (figure 14). This also includes accepting responsibility. This incorporates the other A's since it requires autonomy or ability to do the job; assumption or willingness to do the job; and assignment or ability to work with others and delegate responsibility.

Beyond this structural education and training period, resulting in state licensure and board certification, the remainder of the cardiac surgeon's career revolves around state license renewal, renewing hospital privileges and credentialing, board re-certification (every 10 years for CT Surgery), and continuing medical education (CME). The initial hospital privilege credentialing process may also involve a fixed period of proctoring and/or temporary privileges prior to full unrestricted privileges.

Beyond this, mandated surgical morbidity/mortality conferences, peer review and mandatory reporting in many states of sentinel adverse events or outcomes have become the mainstay of both voluntary and involuntary reporting and tracking of complications, as well as evaluating obvious cases of professional in competence.

This proctoring process is required by many medical staffs[43]. The goal is to assess a physician's technical skill prior to granting full medical staff privileges. This peer review system has become the cornerstone of ensuring quality medical care[44]. The Health Care Quality Improvement Act (HCQIA) of 1986 created the National Practitioner's Data Bank (NPDA). This outlines the whole process of peer review, in terms of how reviews are conducted and physicians protected. Implemented in 1995 the NPDA authorized the Secretary of Health and Human Services (HHS) to establish a registry that restricts the ability of unethical or incompetent doctors to move within the states with out documentation of previous damaging or incompetent performance[45]. Basic to this whole concept of compli cations and accountability is the development of an attitude of maturity and sensibility. This requires both personal and group professionalism and collegiality . Professionalism carries with it three elements[1,46]. Knowledge implies acquisition of a predetermined period of training and education, and a life-time of continuing application of this knowledge with constant relearning and acquisition of new and evolving information and shills[2]. Altruism is the commitment to patients and society and adherence to a code of ethics (Hippocratic Oath)[3]. Self - regulation revolves around accepted standards and regulations for education, training, performance, and competency. This all translates into the expectancy that physicians act with integrity and skill in their relationships with peers, staff, patients and families. Patient confidentiality enters the equation at this point. Discussions at the bedside, as well as discussions of other health care professionals regarding physicians, care, recommendations, and opinions must be tempered with professionalism and caution. Loose lips do sink ships. Human behavior in this area is hard to modify and temper. The Health Insurance Portability and accountability act of 1996 (HI PAA) *(http://www.hhs.gov/ocr/hipaa/privacy.html*) has created standards for the privacy of individually identifiable health information. This law also protects the patients rights to health coverage during certain situations. (*http://cms.hhs.gov/hipaa/onlin e/default.asp)*

Medical malpractice is the legal process through which the patient or family seeks financial retribution for all eged negligence or incompetence resulting in an adverse outcome. There is a crisis in medicine today related to the increasing malpractice suits, large settlement and increasing malpractice premium costs. Tort reform at the state and federal level has become a major priority given the increasing direct and indirect financial impact on the overall healthcare system.

Once again it is important to stress that the largest contributor to errors or complications is system failure[47]. Surprisingly, there has been a decrease in overall medical adverse events from 1972 to 1992. The current rate is below 3%. It is also noted that cardiothoracic surgery accounts for about 3% of malpractice claims noted in the Physicians Insurers Association of America (PIAA) database[48]. The components of a malpractice lawsuit are illustrated in (Figure15)[49]

Figure 15 : Anatomy af a suit[49]

Plaintiff's complaint	Summons-complaint and venue Verification (Bill of particulars)
Defendant's answera Dyscovera	Interrogatories Requests for production Documents Name of witness Depositions Plaintiff Defendant Motionsa Trial (judge or jury) Appeals (not always)

[a] *These steps do not always occur in this order*

One area not noted is settlements. The important point to stress regarding a settlement is that it is reported as a lost malpractice suit, which is subsequently recorded in the National Data Bank[49]. Prevention of malpractice is nicely summarized in (Figure 16)[48] .

+ Two risk calculators-simple additive standard Euro Score (Roques. F. NashefSA, Michel. p. et al. Risk Factors and Outcome in European Cardiac Surgery : Analysis of the Euro Score multinational database of 19,030 patients. Eur J Cardiothoracic Surg 1999; 8:16-22) and thefulliogistic Euro Score (Roques. F. Michel. p. Goldstone. AR. Nashef, SA Logistic Euro Score. Eur Heart J 2003; 24:882-883). The later gives more accurate risk predictions for higher risk patients.

Figure 16[48] : Prevention of malpractice

1. Listen patiently.
2. Respect the patient's dignity and privacy.
3. Return phone calls promptly.
4. Be polite.
5. Be on time.
6. Have the patient join in decision-making. Allow time for reflection.
7. Keep patient's expectations in line with reality (prepare them for all eventualitie s).
8. Be honest about a mis adventure (never cover up or try to blame other s).
9. Avoid high-ri sk situati ons such as cases you are not fully
10- Treat the patient as you would to be treatred

Clearly, trusting and caring physicians who are honest, sincere and have performed everything in the best interest of the patient, will avoid the majority of lawsuits. Yet we cannot ignore the medical malpractice crisis in the USA (especially in 19 states)[50]. This translates into decreased access for patients because of an inflated cost of medical liability premiums. The adage of crisis precipitates change is long over due. A recent survey of 4 Florida counties revealed 94% of CT surgeons have been sued with an average of 3.62 lawsuits each thus far in their surgical careers[50].
Combining the elements of practice guidelines and malpractice prevention into a useful checklist for the operating surgeon is summarized in (Figure17).

Figure 17 : Surgical consideration

Preoperative Counselling :
Patient; family; relative; appropriate others; referring primary and specialist
HIPAA Compliance
Operative :
Indications: relative/absolute
Contraindications: relative/absolute
Timing: when/where to operate (level of facility capability)
Techniques available : Various methods; aggressive; conservative; palliative; curative
Technique employed : knowledge, familiarity
Complications :
(major/minor)
Preoperative risks; comorbidity
Operative – predicted; unpredicted
Early postoperative < 30 days
Late postoperative > 30 days
Chronic/residua/sequela

Post-operative :
Disclosure – too much; too little information re. complications/outcome*

**Mavroudis, C., Mavroudis C.D., Naunheim, K.S., Sade, R.M. Ethics in Cardiothoracic Surgery-Should Surgical Errors Always be disclosed to the patient? Ann. Thorac. Surg 2005; 80:399-408*
- A debate regarding a surgical error that allowed the operating surgeon the opportunity to hide or conceal the information from family members following the patient's death.

Pre-operative counseling is a crucial phase. It is there that the risks and benefits are discussed. Risks include complications. Whether these complications should be broadly discussed or detailed, including written information is a matter of debate. In any event, complications related to the patient's problem, related comorbidity, and the extent of surgery should be openly presented and discussed. The disclosure of complications perioperatively is also a debated issue. Certainly disclosure to patient, family , and discussion at morbidity/mortality conference, or peer review is the usual procedure. A useful phrase for consideration is to admit your mistakes, errors, or shortcomings, but don't «advertise». The evaluation and discussions that follow commission, e.g. performance of operations or procedures, again do not include omission, e.g. operations/procedures turned down or rejected. How dramatic was the change in mortality noted in New York state when high risk cases were turned down, and referred out of state! However, when death, complications, or other adverse outcomes occur a useful mnemonic is help ful to follow (Figure 18).

Figure 18 : The ABCDE Mnemomc for Breaking Bad News

Advance preparation
Arrange for adequate time, privacy and no interruption (tom pager off or to silent mode).
Review relevant clinical information.
Menta1ly rehearse, identify words or phrases to use and avoid.
Prepare yourself emotionally.
Build a therapeutic environment/relationship
- Determine what and how much the patient wants to know.
- Have family or support persons present.
- Introduce yourself to everyone.
- Warn the patient that bad news is coming.
- Use touch when appropriate.
- Schedule follow-up appointments.

Communicate well
- Ask what the patient or family already knows.
- Be frank but compassionate; avoid euphemisms and medical jargon.
- Allow for silence and tears; proceed at the patient's pace.
- Have the patient describe bis or ber understanding of the news; repeat this information at subsequent visits.
- Allow time to answer questions; write things down and provide written information.
- Conc1ude cach visit with a surnmary and follow-up plan.

Deal with patient and famlly reactions
- Assess and respond to the patient and the family's emotional reaction; repeat at cath visit.
- Be empathetic.
- Do not argue with or criticize colleagues.

Encourage and validate emotions
- Explore what the news means to the patient.
- Offer rcalistic hope according to the patieut's goals.
- Use interdisciplinary resources.
- Take rare of our own needs; be attuned to the needs of involved house staff and office or hospital personnel.

* *Adapted from Rabow MW, McPhee SJ Beyond Brequipped to+*

Pre-operative Phase

RISK ASSESSMENT/SEVERITY SCORES

Let us now look at complications in a temporal setting. As mentioned,open-heart surgery has become increasingly important in terms of access, cost, and results, particularly in the setting of a sophisticated public awareness which desires more information regarding both surgeon specifie and institutional outcomes. This information is now readily available on the internet (Table 2, 3, 4).

Table 2 : Iatrogenic Deaths in the United States*

Iatrogemc Deaths in The United States (Deaths induced inadvertently by a physician or surgeon or by medical treatment or diagnostic procedures)		
Condition	**Deaths**	**TOTAL**
Adverse Drug Reactions	106,000	$12 billion
Medical error	98,000	$2 billion
Bedsores	115,000	$55 billion
Infection	88,000	$5 billion
Malnutrition	108,800	.....
Outpatients	199,000	$77 billion
Unnecessary Procedure	37,136	$122 billion
Surgery-Related	32,000	$9 billion
TOTAL	**783,936**	**$282 billion**

** (http://www.ourciviliztion.com/medicinelusamed/deaths.htm)*

Source	**Targeted audience**	Communication media	Information available
American college of Cardiology/ American Heart	Patients needing CABG (nationwide)	Internet (http://www.acc.org/clinical/guidelines/bypass/bypass7.htm Internet (http://www.ahcpr.gov/)	Literature-based indications for CABG
Association Agency for Health Care quality	Broed base of Broed base of health care consumers and providers	Intemct (http://www.ahcpr.gov/)	Large knowledge base focusing on empowering consumers to judge health care quality. In hospital CABG mortality data from 1998
Calofornia Office of statewide health Planning and Development Canadian Health Care System	Patients who purchase healthcare insurance in California provide consumers witrh hospital outcomes for various procedures that might indicate quality at a given hospital all interested consumers	Internet (http://www.ospd.cahnet.gov/hpp/ccmsp/ccmrp summary.pdf) Internet (http://www.hcscgc.ca/ohihbsi/available/conference/presentation/guerriereе.pdf	Risk-adjusted hospital mortality rates for Canadian hospitals
Cochrane Collaboration	All interested consumers	*(http://www.cochrane-consumer.com)*	ummarized available published evidence about a wide variety of health care interventions including cardiac surgery.
Darmouth University	Use large healthcare databases to inform the public of nationwide trends in health care delivery	Internet *(http://www.dartmouthatlas.org/99US/chap* 5 sec 12.php	CABG mortality rates across the U.S. based primarily on claims databases
Health Care Choices	New York not-for-profit corpration dedicated to educating the public about the nation'shealth care system	Internet *(http:www.healthcarechoices.org/cardiacsurgeryo.htm)*	Select state CABG mortality rates, primitive attempt to collate data about physicians. Not nearly complete enough but evolving
Health finder	NIH government sponsored information web about a wide variety of medical problems	*http://www.healthfinder.gov/healthcare*	Geneal information in fairly specific detail about cardiac procedures (with drawing and diagrams)
Healthoutcomes.com	Patients requiring operation or catheter based intervention nationwide	*Internet (http://www.healthoucomes.com*	In hospital outcome for medicare patients having selected procedures (e.g.CABG)
The Leapfrog group (consortium of fortune 500 companies and health care insurers	Provide concumers with list of hospitals that employ leapfrog defined quality measures	*Internet (http://www.leapfroggroup.org/index.html*	List of hospital that use quality measures. Hospitals that use quality measures will be financially rewarded ly Leapfrog group
Medscape Inc.	Consumers information source for all types of medical conditions and for preventive medicine	*Internet (http://www.medscape.com)*	Comprehensive, searchable website with multiple links to external sites capable of finding comprehensive information about details of cardiac surgery.
The National Quality Forum	Provides to the public a standardized set of measures and framework for improving the quality of cardiac surgery	*Internet (http://www.qualityforum.org)*	The set includes 21 hospital level measures that facilite efforts to achieve higher levels of patient safety and better outcomes for patients.
New Jersey State Department of Health	Patients having cardiac procedures in New york tate	*Internet (http://www.health_state_ny.us)*	Surgeon specific and hospital in hospital mortality rates for CABG
Pennsylvania Care Cost Containment Council Rand Corporation	Patients who require CABG in the state of Pennsylvania	*Internet (http://phcl.org)*	Hospital and surgeon specific CABG mortality rates
Rand Corporation	Provide the public with results of cardiac surgery	*Internet (http://www.rand.org/publications)*	Summary of publicly available CABG mortality rates with critical appraiseal of methods and some estimation of appropiates of care

Society of Thoracic Surgeons	Provide the public with results of cardiac surgery over as broad of a population as possible (including VA, Northern New England Consortium, and Great Britain	*Internet (http://www.ctsnet.org/section/oucomes/)*	Mortality and other outcomes data for thoracic procedures. Some of the data is presented as raw mortality data without data risk adjustment. One of the only databases that includes non cardiac surgery
Sohncient Corp. Inc. (Top 100 Heart Hospital)	Provide the public with rather arbitrary rating of overall quality of cardiac care	*Internet (http: www.100tophospitals.com)*	Rates all hospitals in the U.S. that do cardiac surgery and lists the tgop 100 heart hospitals
Washington Post Meical website	Provider of medical information reports to consumers in Noth America	*Internet (http://www.medifocus.com)*	General information about cardiac disease
Webmd Inc.	Provide information to consumers and physicians about a broad spectrum of health care issues	*Internet (http://www.web*	Information about CABG and expected outcomes
Women's Heart Foundation	Provide health related	*Internet (http:www.womensheartfoundation.org)*	Links to internet available report cards on cardiac surgery

They are essential tools for risk assessment, cost analysis and over all assessment of patient benefit.

The major determinants of perioperative morbidity and mortality remain age, sex, body surface area, acuity of the operation (elective, urgent, emergency), associated co-morbiditi s (especially smoking, diabetes, obesity, renal dysfunction, hypertension, stroke, chronic obstructive pulmonary disease, and peripheral vascular disease); and the degree of cardiac dysfunction.

Univariate analysis is used to correlate a particular risk factor with a specific outcome, which is the methodology utilize d in the Society of Thoracic Surgeons (STS) database (Figure 19).

Figure 19 : particular risk factor

Demographics	Age, Gender
Acuity/Priority	Elective/urgent/emergent Comorbidities Smoking Diabetes Morbid obesity Renal failure Hypertension Stroke COPD Peripheral vascular disease Cerebrovascular disease
Cardiac disease	Recent MI Type of angina Cardiogenic shock Preoperative arrhythmias Preoperative meds (diuretics, inotropes, antiarrhythmics, NTG)

**Current Core STS data elements and definitions available at HYPERLINK «http://www.sts.org/doc/4502» http://www.sts.org/doc/4502*

? Bojar RM. Manual of Perioperative Care in Cardiac Surgery. Third Edition Malden, MA, Blackwell Science, 1999, p80

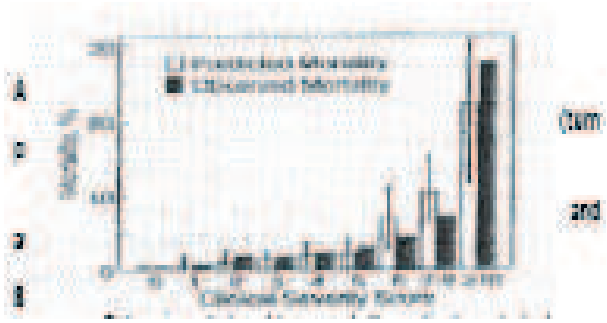
This calculation is difficult to assess when multiple factors are involved. In multivariate regress ion analysis, only those variables found significant in univariate analysis are used to assess the independent association of these variables with specific outcome or results.

Several multivariate risk modes allow for bedside calculation of operative risk, including the Parsonnet scoring system which is one of the earliest[65]. The Cleveland Clinic (CCF in Table 3) severity scoring system is practical in that the score is directly correlated with predicted mortality (Figure 20a,b)[59]

Figure 20 (a) : Cleveland Clinic Clinical Preoperative Severity Scoring System*[59]

Preoperative Factor	Factor
Emergency case	6
Creatinine > 1.6-1.8	1
Creatinine > 1.9 4	4
Severe LV dysfunction	3
Reoperation	3
Mitral regurgitation	3
Age 65-74	1
Age > 75	2
Prior vascular surgery	2
COPD	2
Hematocrit < 34%	2
Aortic stenosis	1
Weight < 65kg	1
Diabetes	1
Cerebrovascular disease	1
Maximum Score	31
Relevant range	0-13+
COPD - chronic obstructive pulmonary disease LV - left ventricular	

** The correlation of the clinical severity scoring system with mortality at the Cleveland Clinic (Source : higgiens TL, Estafanous FG, Loop FD, et al. Stratification of morbidity and mortality outcome by preoperative risk factors in coronary artery bypass patients. JAMA 1992;265:234-238[59]*



Determine what and how much the patient wants to know. Have family or support persons present. Introduce yourself to everyone. Warn the patient that bad news is coming

The Northern England risk includes CABG and valve surgery risk (Figure 21[66])

Figure 21[66]:Risk algorithm Northern New England

Preoperative estimation of risk of CABG or aotic valve mortality			
Patient or disease characteristic	CABG mortality score	Aprtic valve mortality score	Mitral valve mortality scoe
Age 60-69	2.5	1.5	1.5
Age 70-79	4.0	2.0	3.0
Age > 80	11.0	3.0	3.0
Female sex	2.0		1.5
EF < 40 %	1.5	1.0	
NYHA 1b		1.5	1.0
NYHA 1c			2.0
LVHDP 30			1.5
Urgent surgery	2.0	1.5	2.0
Emergency surgery	9.0	5.5	6.0
Prior CVA			1.5
Prior CABG	3.0	1.5	
FVD	1.5		
CHF		2.0	1.5
Atrial fibrillation		1.5	1.4
CAD	1.5		1.5
Disheets			1.5
Dialysis or creatinine 2	2.5		1.5
BSA < 1.70	2.0	1.5	
BSA 1.70-1.99		1.5	
Mitral replacement		1.0	
Concomittant CABG			2.0
Total score		1.5	
Preoperative risk			
Total score	**Mortality (%)**	**Aortic (%)**	**Mitral (%)**
< 3	< 0.4	< 1.8	< 0.6
3	0.4	1.8	0.6
4	0.6	2.2	0.9
5	0.8	3.1	1.1
6	1.2	3.6	1.5
7	1.5	5.1	2.0
8	2.1	6.6	2.7
9	2.8	8.5	4.0
10	3.7	11.9	4.8
11	4.6	15.1	7.1
12	6.6	17.2	9.2
13	5.2	23.7	11.6
14	9.9	31.4	17.0
15	7.3	36.9	19.6
16	9.6	43.0	26.6
17	12.0	> 43.0	34.0
18	15.8		41.2
19	31.6		48.0
20	< 31.7		> 60.0

The Euro Score is an additional risk source which is available for on.line calculation. *www»euroscore.org+*
Specifically, the risk of advanced age has become important and relevant in terms of access to care, cost and outcome. At present, three percent of Americans are octogenarians, and by 2010 there is projected to be an increase to 4.3%, representing 12 million people[67]. Between 1987 and 1990 there was a 67% increase in cardiac surgery in this age group[68]. Mortality and quality of life are the prime indicators of success in this age group. Operative mortalities between 7.9% and 13.5% have been reported in octogenarians, with one study reporting a 5-year median survival of 55%, compared to 69% in age group 70-79 years, and 81% for age group 60-69 years[68]. Utilizing Standard Form 36 Health questionnaire (SF-36 form) and the Seattle Angina Questionnaire, 83.7% of the octogenarian surgical patients were living at home with 74.8% enjoying good or excellent health[69] (Figure 22).

Figure 22 : Seattle Angina Questionnaire

Short form 36 (SF 36)	Seattle angina questionnaire	Michigan Health profile
Physical functionning	Extional capacity	Mobility
Social functionning	Angina stability	Pain
	Treatment frequency	Energy
Role limitations physical	Treatment satisfaction	Sleep
Emotional	Disease perception	Emotional perception
Mental health		Social isolation
Energy/Vitality		
Pain		
General heealth perceptions		

Females remain at higher risk for myocardial revascularization. Iwo basic studies show a two-to-three fold increase in mortality for women versus men[70,71]. Waiting lists for emergency, urgent, or elective cardiac surgery has ceased to be a problem in the United States, with the exception of heart, and heart-lung transplantation. Unfortunately, cost effectiveness and efficiency can be problematic in some cases where preoperative counselling and more complete evaluation of the disease process or comorbidity are not approached. In other countries waiting lists pose a problem or challenge. Rexius et al[72] from Sweden noted a median waiting time for CABG of 55 days. There was a 1.3% mortality in the 5,864 patients waiting for elective surgery. Cesena et al[73] from Brazil noted a median waiting time of 126 days. There was a 2.5% mortality in a group of 516 patients. Impaired LV function was a major risk factor for death in both groups.
Interestingly none of the risk scores for myocardial revascularization include either hospital or surgeon specific volumes as specific risks for mortality or adverse outcome. At least nine large studies have addressed the notion that hospitals performing small numbers of CABG operations have higher operative mortality[74-82]. Six of these nine studies found increased operative mortality in low volume providers[74-79]. In three other studies there was no correlation[77-79]. The Institute of Medicine summarized the relationship between higher-volume and better outcome «*(www.nap.edu/catalog/IOO5.html)*» and concluded that procedure or patient volume is an imprecise indicator of quality even though a majority of the studies reviewed showed some association of higher volume and better outcome[83]. The observations on operator volume and

outcome have prompted some to suggest «regionalization» i.e. to refer non emergent CABG patients to large volume centers[79,84]. The role for «selective regionalization» was advocated by Nallamothu et al[82] when they found that low risk patients did equally well in high volume or low volume hospitals. They suggested regional referral for elective high risk patients to high volume institutions. Crawford et al[85] pointed out that a policy of regionalized referrals for CABG may have adverse effects on healthcare, including increased cost, decreased patient satisfaction, and reduced availability of surgical services in remote or rural locations. Birkmeyer et al[86] again point out the emphasis on hospital volume by both the Institute of Medicine and the Leapfrog group. Again using Medicare Claims data and the Nationwide Inpatient sample they examined 6 cardiovascular procedures between 1994 and 1999 and noted a 2-5% change in adjusted mortality for valve surgery, and <2% change in adjusted mortality for CABG Surgery. Clearly this debate will continue[87].

A sensitive area of discussion revolves around modalities to adjust risks and outcomes. Referral of high risks patients to high volume centers or out of state shifts the risk, decreases the cost for the referring facility, and lets the surgeon «off the hook». Whether the motive is patient driven, facility driven, or surgeon driven is a matter of speculation. Shahian et al(88) have openly discussed «gaming». This includes upcoding of comorbidities, change of operative class, transfer of postoperative patients to extended care facilities, and avoidance ofhigh risk patients. Inappropriate or excessive coding of risk factors increases the expected mortality rate. Adding mitral valve repair to CABG changes the class from isolated CABG. Finally transfer of patients from acute to chronic care facilities changes the database of deaths occurring where the operation was performed.

Carey et al[89] studied the Califomia statewide discharge database ever a 3 year period. When corrected for transfer to chronic facilities the aggregated 3 year in-hospital mortality rose for CABG (2.98% to 3.45%); CABG plus (9.25% to 10.67%); and valve only (4.85% to 5.45%). Once again, as painted out earlier the SIS defmition of hospital mortality includes patients transferred to chronic health facilities, whose death was attributable to the operation[19].

Operative Phase

A difficult area to gather objective data and document ontoward events is the data dense environment of the operating room or theater. Notable attention has been given to preoperative and postoper ative aspects in the literature, but there is a dearth of objective information re intraoperative events. We assume the infrastructure and design of the operating room is safe and functional. Basic knowledge of OR design and function should be familiar to the cardiac surgeon and the operating team room team. A knowledge of the basic equipment, monitors, and supplies necessary for specific operations is fundamental.

Anesthesia controls IV access, airway, anesthesia, monitoring, and overall patient support during the operation. Recent attention has been given to general and specific anesthesia related complications. Anesthesia complications are not discussed.

Nursing issues in the OR include chart control, patient identification, positioning, prepping, and draping. The OR documentation paperwork is maintained by nursing. Instruments and supplies are usually prepared from physician and procedure specific pereference lists. The recently implemented «time out» routine insures that the right patient is receiving the right operation on the right anatomical part of the body. Positioning is important insofar as pressure necrosis and peripheral nerve injury are concerned events. Cautery burns are documented. A summary of operating room data and events is maintained in the operative nursing record.

The attending primary cardiac surgeon must have a mental checkl ist to assure that the appropriate instruments, suture, and product needed for a specific operation is available, ready, and operational (eg – the surgical sternal saw must be checked and functional prior to use). It is wise and prudent to review and reheare the sequence of the operation with the operating room team prior to the incision. Any specifics or deviation from the routine are better received and discussed prior to the skin incision. Notification of the family or relatives of the progress of the operation at various times during the procedure is considered routine in most programs. Certainly, notification of an intraoperative complication or catastrophe is appropriate. A designated spokes person or protocol is standard in most centers.

Surgeon specific data or the human factor is difficult to quantify and document. The three fundamental requirements for the surgeon include character, personality, and competence. Attempts at objective measurement of the surgical personality offer some insight in to character as well. Mc Greevy et al[90] used the US Air force NEO PIR psychological testing to measure personality traits in surgical residents. Data on the five major personality traits (Neuroticism, Extraversion, Openness,Agreeableness, and Conscientiousness) were analyzed. The Conscientiousness facet analysis was the most revealing.

The traits of conscientiousness include competence, order, dutifulness, achievements triving, self-discipline, and deliberation. All residents, both male and female scored higher in this facet than the general population.

The NEO PI-R is a stable testing modality across the adult lif e span, and consistent in retesting.

Technical proficiency is a basic required surgical trait. Validation of this proficiency historically has been the qualitive assessment by mentor observation. This modality will remain the basis of apprentice-based teaching or transfer of skills. These In-Training Evaluation Reports (ITERs) are composed of global rating scales of technical proficiency evaluated, assessed, and completed at various phases of the surgical residency training period. True validity and reliability remain a major concern[91]. Objective testing and evaluation of technical proficiency and dexterity is gaining more attention.

Guerlain et al[92] have employed a multitrack, synchronized, digital audio-visual recording system (RATE tool) to monitorint raoperative performance. This RATE tool allows analysis of technical judgment, technique, team performance, and communication patterns. Hance et al [93] have adopted an objective system to evaluate technical proficiency and dexterity. It consists of a « bench model» skills assessment for cardiac surgery. The goal is to establish construct validity, which is a means to differentiate varying skill levels. Four skills are assessed - aortic root cannulation, femoral triangle dissection, aorta to vein graft anastomosis, and vein graft to Left Anterior Descending Artery anastomosis. Cadaveric porcine models were utilized. Assessment was performed by senior surgeons utilizing a standard validated evaluation system. This type of assessment protocol will gradually be integrated into many training programs. The perfusionist is a critical component of the operative team. Complications related to cardiopulmonary bypass are beyond the scope of this review . However, all programs are encouraged and often required to formulate perfusion protocols that include routine cases, special cases, and recognition and correction of operative complications i.e. «troubl e-shooting». The cardiac surgeon must maintain a basic knowledge of cardiopulmonary bypass physiology and techniques.

A coordinated communicative network between Anesthesia, Surgeon, Perfusionist, and Nursing is crucial to operative success and avoidance of preventable complications. Probably, the most valuable component of the operative phase, is a regularly scheduled meeting of the operating room team, including the ICU staff, to discuss routine protocols, problems, concers, suggestions, and other items that all contribute to a «smooth running service» . This is a notable example of the Hawthorne effect.

Post-operative Phase

RISKS AFTER ARRIVAL IN THE INTENSIVE CARE UNIT (ICU)

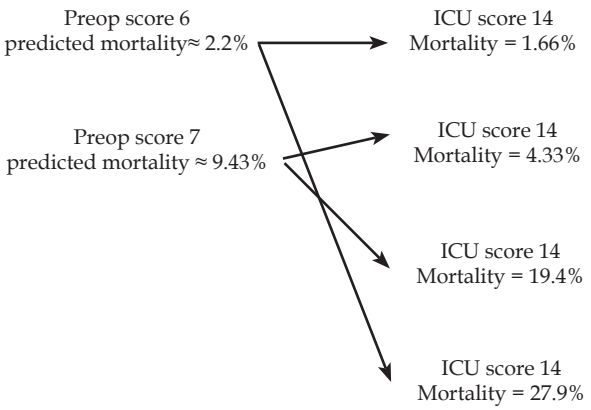
In general, risk is stratified for the overall cardiac surgery experience, including early outcomes for the operative procedure based on preoperative risk factors. The APACHE III score (Acute Physiologic And Chronic Health Evalu ation), however, is used only for non-cardiac surgery risk based on clinical presentation upon arrival in the ICU[94]. Since application of the APACHE III to cardiac surgery is difficult (with many variables changing rapidly due to the manipulation that occurs early), a refined APACHE III was developed for patients undergoing CABG[94] . Independent predictors of survival were acute physiology score, age, emergency operation, reoperation, number of grafts performed and gender .

Higgns et al[95], from the Clevel and Clinic, developed an ICU admission score for predicting morbidity and mortality (Figure 23)

Figure 23 : ICU admission score for predicting morbidity and mortality

Variable		Value
Preoperative factors		
Small body size (BSA<1.7m²)		1
Prior hear operation		
One		1
Two or more		2
History of operation or angioplasty for peripheral vascular disease		3
Age ≥ 70 years		3
Preoperative creatinine ≥ 1.9mg/dl	4	
Preoperative albumin < 3.5 mg/dl	5	
Intraoperative factors		
CPB time ≥ 160 minutes		3
Use of IABI after CPB		7
ICU admission physiologie		
A-a O_2 gradient ≥ 250 mmhg		2
Heart rate ≥ 100 beats/min		3
Cardiac index < 2.1 L. $min^{-1}.m^2$	3	
CVP ≥ 17 mmHg		4
Arterial bicarbonate < 21 mmol/L		4

A-a = Alveolar-arteriol BSA=body surfaces area; CPB= Cardiopulmonary bypass CVP = Central veinous pressure IABP intraaortic balloon pump; ICU= intensive care unit



This allowed sequential assessment of prognosis, and improved This allowed sequential assessment of prognosis, and improved stratification because of a contInliously updated data. For example, the use of intra-aortic balloon counter pulsation (IABP) signified a worsening prognosis likely due to a significant intracardiac event related to degree of pathology, myocardial protection, technical events or extended cardiopulmonary bypass times. Knaus[96] gives a nice historical review of APACHE, noting that over 2000 peer review articles utilize APACHE as a key component for the methods and results section. Assessments have been made for risks after the fust ICU day. Kubn et al[97], utilizing APACHE, noted a mortality of 500/0 for patients

with APACHE score of 28 after the first ICU day. Another consideration is readmission to the ICU.

This is a significant event. Bardel et al[98] noted a 3.6% readmission rate with pre-operative renal failure and initial mechanical ventilation for >24 hour following CABG as risk factors for readmission. Again, prolonged ICU-WS is an independent variable for complications and poor outcomes. Williams et al[99] noted that in a group of 49 patients (3.8% of total over a one year period) remaining in ICU > 14 days had a 28.5% in hospital mortality; compared with 5.3% ofthose in ICU <14 days. At 2 years there were 22 of 35 discharged patients alive (81% survival); or 45% of the original 49 patients. The older Ontario score system (Figure 24) is still useful in correlating overall mortality, ICU-LOS, and Postop-LOS[13].

Figure 24 : Ontario Score : Risk Index for mortality, ICU LOS and PostOp LOS[13]

Risk Factor	Risk Score
Age, Y	
< 65	0
65-74	2
≥ 75	3
Sex	
Male	0
Female	1
Left ventricular function	
Grade 1	0
Grade 2	1
Grade 3	2
Grade 4	3
Type of surgery	
CABG only	0
Single valve	2
Complex	3
Urgence of surgery	
Elective	0
Urgent	1
Emergency	4
Repeat operation	
No	0
Yes	2
Range of scores	

	Observed Mortality Rates, ICU, LOS and Postop LOS by Risk Score in-hospital			
Risk score	Patients %	Mortality Rates %	Mean ICU LOS,d	Mean PostOp LOS,d
0	11,81	0,25	2,27	8,04
1	14,73	0,79	2,39	8,43
2	17,84	1,30	2,81	9,25
3	17,07	2,89	2,89	10,35
4	14,23	4,59	3,16	10,97
5	10,72	5,69	3,31	11,44
6	6,43	8,13	3,68	12,80
7	3,88	11,61	4,33	13,14
≥ 8	3,30	13,22	5,87	14,51

The ICU is a complex environment. Nast et al[100] report a contemporary experience in an ICU setting. The goal was to evaluate voluntary patient safety events. Physicians, nurses, and allied health personal participated. Of 157 events reported 85.54% caused no harm, 48% were human factor related, and 34% organizational or system related. The data highlights the value of voluntary, confidential, non-punitive approaches, used in a constructive manner to identify errors, near misses, and other causative factors.

Long Term Results

Outcomes after hospitalization have become increasingly important in terms of quality of life. Basically, quality of life (QOL) indicators are objective and subjective. Objective health status and function can be assessed directly with patient contact by health care professionals. Subjective assessment is the patients perception of how they feel or are doing. QOL can be generic (eg SF-36; Seattle Questionnaire; Notti gham Health Profil e), functional status, disease specific, or symptom severity. As mentioned, SF-36 form is a short questionnaire with eight multi-item variables (Figure 22)[101]. Falcoz et al[102] found the SF- 36 more suitable for cardiac surgery compared to the Nottingham Health Profile (Figure 22); especially with regards to the assessment of angina and dyspnea. Lindsay et al[103] reported 214 patients undergoing CABG in whom the SF-36 form was used before and after operation. At a mean of 16.4 months postoperatively, the SF-36 score showed that high levels of social support were associated with improved health status and quality of life. Simchen et al[104] in a study from Israel, reported on 1270 patient one year following CABG. One-third reported their quality of life as not good, particularly females and those of lower socioeconomic status. Rehabilitation programs were targeted as the reason for improvement. QOL measures are becoming increasingly utilized as predictors of health related quality of life (HRQL) outcomes. Preoperative SF 36 studies were performed before, and at 6 mos, and 1 year post-operatively. A VA study[105] evaluated 1,973 patients undergoing coronary artery bypass (CABG) surgery before and six months postoperatively. Multivariable analysis targeted current smoking and psychiatric disease as targets for improvement. A French study[106] evaluated CABG and valve patients pre-operatively and one year postoperatively. Functional status was better for valve patients with NYHA functional class or and angina class or as predictors of impairment at one year. These quality of life measures following CABG will undoubtedly become more important as the population ages. More importantly, six month and twelve month outcomes in terms of mortality may be better indicators for quality assurance than the traditional 30 day or hospital mortality reporting.

COST

The number of Medicare patients has risen to over 40 million, with the number of uninsured rising to an almost equal number. Access to care and rising costs continue to challenge healthcare providers. The Health Care Financing Administration [HCFA: now called Centers for Medical and

Medicaid Services (CMS)] budget has risen from 21.5 billion in 1977 to 214.6 billion in 1997[107], with treatment for coronary artery disease accounting for more than 80 billion of that cost, and CAD continuing to be the leading cause of death and morbidity in the USA. The total cost of cardiovascular disease and stroke in the USA in 2005 is estimated at $393.5 billion. (Figure 1) This includes the direct costs of $241.9 billion and the indirect costs of $151.6 billion (lost productivity morbidity and mortality).

This all translates in to approximately 16% of GNP spent on healthcare. At the same time, expensive medical technology continues to grow and develop. With the escalating costs of cardiac surgery, attempts have been made to find effective ways to reduce these costs while maintaining good outcomes. Beginning in the last decade, individual cardiac surgeon and institutional results in New York State were made available to the media and public, causing outcries both within the medical establishment and the general public[108]. CMS has mandated progressively lowering reimbursements, utilizing DRG's for cardiac surgical procedures, in a further attempt to control the continuing growth of operations and cost.

Initiated in 1983, Diagnosis- related-groups or DRD's are reimbursed fixed fees for each patient admission, regardless of the provider's actual incurred costs. These prospective payments shifted financial risk from payers to hospitals. Adopted by other third party payers, variations of payment have evolved, including «capitation» or lump sum payment for all in patient care. The reimbursement for cardiac surgery from Medicare decreased 9.3% from 1991 to 1997[102]. With a rising population at risk and the in flux of the baby boomers into this patient mix , financial issues will become even more critical and relevant.

The specific cost of CABG has been studied extensively, with particular attention given to preoperative risk factors and complications, both of which increase length of stay (LOS). Taylor[109] prospectively studied 500 patients undergoing CABG, and found a charge of $11,900+12,700. No preoperative clinical features were significant predictors of cost, whereas postoperative sternal wound infection, respiratory failure and LV failure were. Ferraris et al[110] studied hospital charges in 938 patients undergoing CABG. They found that risk factors for postoperative morbidity are different than those for postoperative mortality. Their findings suggested that older patients with preoperative anemia and low blood volume who also have other comorbidities (CHF, stroke, COPD or hypertension) are at increased risk for postoperative complications and increased hospital costs. The most costly outcome in their study was perioperative death. Cohen et al[111], analyzed hospital cost, (not charges) for 89 elective CABG patients with an average postoperative LOS of 9.3 days and found the total costs were from $17,420, $19,153 and $21,828 for the 25th, 50th and 75th percentiles, respectively. Williams et al[112], found increased cost to be correlated with high aver age risk (utilizing the Parsonnet equation) and increas ed LOS in 2,589 CABG patients. Shahian et al[113], however showed no correlation between hospital size, volume of surgery and cost.

Strategies to decrease cost include operating on lower risk patients, more expedient surgery (i.e. on the same admission as diagnostic catheterization, same day admissions, decreasing ICU and restrictive hospital stay, improved home care, and greater use of chronic care facilities and rehabilitation centers). Shorter LOS in the acute car e hospital, however, has led to increased readmission rates, and more frequent discharges to chronic facilities, along with increasing utilization of home health services. Lazar et al[114], demonstrated a distinct change from 1990 to 1998, with discharge-tohome-with-services increasing from 14.75% to 46.5%, and transfer to rehabilitation units increasing from 2.9% to 13.7%. Readmission rates fol lowing cardiac surgery range from 5.3% to 20.9%[114-118]. Preoperative risk factors associated with increased readmission rates include female sex, diabetes, chronic lung disease and preoperative atrial fibrillation[117-118]. The most common readmission diagnoses have included atrial fibrillation, angina, congestive heart failure, ventricular tachycardia, wound problems, pneumonia and gastrointestinal complaints[115].

Evidence-Based Medecine (EBM)

EBM provides a basis for the evaluation of treatment and application to a specific clinical problem or situation. Meakins[119] nicely summarizes the five steps in EBM : define the question or problem; search for the evidence; critically evaluate the literature; apply the results; and audit the outcome. A number of resources have emerged as a source EBM information i.e. (*www.clinical evidence.org) (www.ebmny.org), (www.cochrane.org*).

Familiarity with the precepts and principals of EBM will help facilitate the organization of a large amount of information and enable the practitioner to answer clinical questions at the point of care in real time. It is important to note the historical contribution of Archie Cochrane to the EBM concept[21,120,121]. A quote summarized hisrtionale: «I had considerable freedom of clinical choice of therapy: my trouble was that I did not know which to use and when. I would gladly have sacrificed my freedom for a little knowledge[21]». Thirty years later we are a lot closer to that knowledge.

Simply put evidence is the link between what we know and what we do in medicine. EBM is designed to achieve optimal management of clinical problems or challenges. From this, practice management guidelines, paradigms and algorithms can be developed. The ultimate focus of risk stratification and outcome assessment is to account for differences in patient risk factors so that patient outcomes can be used as an indicator of quality of care. A major problem arises in attaining this goal because uniform definitions of quality of care are not available. A grading or standardized classifications system has emerged that recognizes the difficulties in defining «best practices» for a given illness or problem. Professional organizations have opted to promote practice guidelines or «suggested therapy» for given disease[122,123] (Figure 25, 26).

Figure 25 : grading of Recommandations and Levels of Evidence*

GRADE A	
Level 1a	Evidence from large randomized clinical trials (RCTs) or systematic reviews (including meta-analyses) of multiple randomized trials which collectively has at least as much data as one single well-defined trial.
Level 1b	Evidence from at least on "All or None" high quality cohort study; in which ALL patients died/failed with conventional therapy and some sur vived/succeeded with the new therapy (e.g. chemotherapy for tuberculo sis, meningitis, or de-fibrillation for ventricular fibrillation); or in which many died/failed with conventional therapy (e.g. penicillin for pneumo coccal infections).
Level 1c	Evidence from at least one moderate sized RCT or a metaanalysis of small trials which collectively only has a moderate number of patients.
GRADE B	Level 1d Evidence from at least one RCT.
Level 2	Evidence from at least one high quality study of non-randomized cohorts who did and did not receive the new therapy.
Level 3	Evidence from at least one high quality case control study.
Level 4	Evidence from at least one high quality case series.
GRADE C	
Level 5	Opinions from experts without reference or access to any of the foregoing (e.g. argument from physiology, bench research or first principles).

**Adapted from (122) Yusuf S, Cairns JA, Camm AJ, Fallen EL, Gersh BJ. Evidence based Cardiology. 1998 BMJ Books, London p2*

Figure 26 : ACC/AHA Classification for Guidelines Series[123]

The ACC/AHA classifications I, II and III are used to summarize indications as follows:

Class I	Conditions for which there is evidence and/or general agreement that a given procedure or treatment is usefulClass
ClassII	Conditions for which there is conflicting evidence and/or a divergence of opinion about the usefulness/or efficacy of a procedure.
Class IIa	Weight of evidence/opinion is in favor of usefulness/efficacy.
Class IIb	Usefulness/efficacy is less well established by evidence/opinion.
Class III	Class III: Conditions for which there is evidence and/or general agreement that the procedure/treatment is not useful/effective and in some cases may be harmful

These guidelines or recommendations represent a compilation of available published evidence, including randomized trials and risk adjusted observational studies, as well as consensus among panel of experts proficient at treating the given disease[115]. For example, the practice guideline for coronary artery bypass grafting is available on the internet *(www.acc.org/clinical/guidelines/bypass/ExecIndex.htm)* for both practitioners and the lay public. (Figure 27)

Figure 27 : 1999 AHA/ACC Guidelines for CABG in ST-segment elevation (Q-wave) MI[123]

Indication and clinical condition	Definition of level of evidence
Class I None	Class I : Conditions for which there is evidence and/or general agreement that a given procedure or treatment is useful and effective.
Class IIa 1. On going ischemia/infarction not responsive to maximal therapy. Class IIb : 1. Progressive LV pump failure with coronary stenosis compromising the initial infarct area. 2. Primary reperfusion in the early hours (<6 to 12 hours) of an evolving ST-segment elevation MI.	Class II: Conditions for which there is conflicting evidence and/or a divergence of opinion about the usefulness or efficacy of a procedure. Class IIa: Weight of evidence/1. opinion is in favor of usefulness/efficacy. Class IIb: Usefulness/efficacy is less well established by evidence/opinion.
Class III : 1. Primary reperfusion late is (>12 hours) in evolving ST-segment elevation MI without ongoing ischemia	Class III: Conditions for which there is evidence and/or general agreement that the procedure/treatment is not useful/effective and in some cases may be harmful

Figure 27 illustrates the 1999 AHA/ACC Guidelines for coronary artery bypass grafting in patients with acute (Q-wave) myocardial infarction. These guidelines were developed using a summation of available randomized controlled trials, risk adjusted observational studies, and expert consensus. They are meant to provide clinicians with accepted standards of care that most would agree upon, with an ultimate goal of limiting deviations from accepted standards. Guideline development continues to represent a work in progress. The methodology for developing guidelines for disease treatment is evolving. Many published guidelines do not adhere to accepted standards for developing guidelines[124]. The area where greatest improvement is needed is in the identification, evaluation and synthesis of the scientific evidence.

An implicit part of assessing outcome is the development of a best standard of care for a given illness or disease process. Once the most efficacious treatment is known then comparisons with, or deviations from, the standard can be assessed - a process called «benchmarking». As mentioned above, the «best standard» is not always known. Meta-analysis is a quantitative approach for systemically assessing the result s of multiple previous

studies to determine the best outcome. The overall goal of meta-analysis is to combine the results of previous students to arrive at a consensus conclusion about the bet outcome. Stated in a different way, meta-analysis is a tool used to summarize efficacy studies (usually RCT's) of an intervention in a defined population with disease in order to determine which intervention is likely to be effective in a large population with similar disorder.

Meta-analysis is a tool that can relate efficacy studies to effectiveness of an intervention by summarizing available medical evidence. To date EBM recommendations are slowly evolving regarding the perioperative care of the cardiac surgery patient. In addition to EBM indications for coronary acting bypass grafting, similar guidelines are available for valve surgery *(www.acc.org/clinical/guidelines/valvular /dir index.htm) .*

Teaching and incorporationg EBM into Clinical training programs has developed[125]. The American College of Surgeons has established the Office of Evidence- Based Surgery (OEBS)[126]. They have utilized the four steps as developed by Sackett et al[127] :

(1) Formulate a question based on a clinical situation encourtered in daily practice.

(2) Do a focused search of the relevant literature.

(3) Critically appraise the literature obtained to find the best evidence.

(4) In tegrate the information and act in accordance with the best available evidence.

So who is involved in these 4 steps. The individual surgeon can accomplish (step 1 and 4). A librarian or independent Pub Med search can identify the available literature (step 2). Critical appraisal is the difficult area. Interpretation of the literature and statistical knowledge can be a formidable challenge (step 3). Research coordinators and unbiased committees within the concerned societies are in the best position to generate overall recommendations. Yet the individual surgeon must have a basic understanding of statistics. Critical analysis of the literature is crucial to the process of understanding and making any necessary changes or adjustments in one's clinical practice[128]. Since approximately 30% of journal articles may contain errors a basic knowledge of statistics and research design is useful[128].

Formulating the question (step 1) is basic to the EBM process. The clinical question is formulated as PICO[129]:

P - Patient/problem

I - Intervention

C - Comparison

O - Outcome(s) of interest

A clinical example is given :

What is the value of laser transmyocardial myocardial revascularyation (TMR) with no option angina.

P - Patient with unstable angina or bypassable lesions

I - TMR

C - No TMR

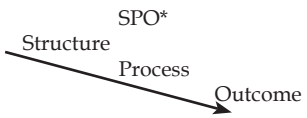
O - Early, mid, or long term results.

Dunning et al[129] have nicely organized a best evidence series in cardiac surgery. A structured protocal has been constructed to answer the patient problem (p) : Introduction; Clinical scenario; 3 Part question (eg - No option angina; TMR; angina relief or survival) ; search strategy; search outcome[130,131]. Outcome analysis has become the ultimate test of all of our efforts. This has been clearly echoed by Donabedian: «Outcomes are much more easily used… only as cues that prompt and motivate the assessment of process and structure in a search for causes that can be remedied[132,133].» Further, Donabedian views quality as the ultimate goal. It depends on 2 interdependent variables : technical and interpersonal. Technical is basically our craft or what we do; interpersonal is interaction with our patients, balancing their needs and wants.

Quality Assurance/Quality Improvement

The ultimate goal is to make the surgical operation safer and minimize on toward results or complications. The search for the Holy Grail of perfection will continue, or, in economic terms, for high quality providers or valuebased purchasing. The experts agree that humans cannot perform flawles sly and the expectation of perfection is unattainable. Reason[17] and Sundt[31] have emphasized structure or systems with human components as a part. This structure or system starts or continues a pr ocess or function. Finally the outcomes or results are analyzed, evaluated, recorded, and subsequently reported. Birkmeyer et al[134] has beautifully outlined the structure, process, and outcome process (Figure 28).

Figure 28 : Summation



Structure

- Surgeon - Character/Personality/Competence - Human Factor- Staff - Support - Team - Product Line - Clinical Care Pathways - Hospital - infrastructure/volume/resources - Systems - Patient - Risk assessment

Process

- Effective - EBM (evidence-based-medicine)
- Safe - Surgeon/System related
- Timely - waits/delays
- Efficient - Cost control/Personal waste
- Patient centered - Individual Focus
- Equitable – Quality to all served

Outcome

- Surgeon participation
- Evaluation/Database
- Methods of analysis
- Results/Critiques/"Report Card"
- PDSA cycle (Plan/Do/Study/Act) (see Figure 9)

** Modified from (134) Birkmeyer, JD, Dimick, JB. Birkmeyer, NJ Measuring the quality of medical care; Structure, Process, or Outcomes? J Am Coll Surg 2004;198:626-632*

Surgical competence and proficie ncy r emains a key component of the structure, process, and outcome (SPO) cascade. Satava et al[135] have summarized the ACGME six components of competence (Figure 13) and add proficiency as the level of performance in each area of competence. To maintain proficiency requires evidence of professional standing, lifelong learning and quality improvement, cognitive expertise, and practice performance. Unless the surgeon and surgical community engage in maintaining competence/proficiency, as well as buying in or investing in the total SPO effort, the entire effort will be compromised.

A useful and practical device that br idges the statistical and tactical aspects is the critical paths or pathways. Utilizing clinical guidelines as a basis these pathways are designed to reduce vari ation in care, decrease resource utilization, costs and, hopefully, improve quality[136]. One potential weakness in this approach is application to the complicated or «less ideal» patient.

Outcome analysis has received the most attention in this quality assurance effort. Certain lessons have been learned: Crude mortality is not enough; differences related to chance and casemix do make a difference; disclosure of results to the general public can encourage potentially harmful consequences; and data collection requires organized and experienced individuals and teams.

On a practical note, the available database record should be initiated early in the process, usually at the time of surgery. Computer entry following the operation by an unbiased, designated database person is recommended, and cruci al to the process. Subsequent perioperative events are recorded at the time of discharge. Partiality re. what events took place or what constitutes complication remain a sensitive and controversial area. Again, the discharge coding (ICD-9) is crucial to subsequent chart reviews[39]. The computer tool s and systems utilized to collate, analyze, and validate the data and make subsequent conclusions and recommendations continue to evolve.

There are 3 risk-adjustment database systems presently being used by many centers and groups: National Surgical Quality Improvement Program (NSQIP); DXCG; and Charlson Comorbidity Index (CCI)[137]. The NSQIP utilizes medical record abstraction, whereas the other 2 use secondary data produced by hospitals for accounting/ billing purposes. These last two utilize ICD-9 Codes. Blackstone, Rogers, Spiegelhalter, and Treasure have nicely summarized the outcome analysis process and debate, with particular attention to CUSUM or cumulative sum charts[27-30]. This charting system is designed to identify deviation from a performance standard. Its forte is that it provides early warning signs for subtle changes or problems in a system. Whereas the CUSUM methods examine overall surgical outcomes, it does not compensate for variable case mix . VLAD charts (Variable Life Adjusted Display) address this situation[138] That probably sums up the whole purpose of report cards – recognize problems early and offer solutions, rather then affixing blame. Herein lies the strength of the Northern New England study group. *(www.nnecdsg.org/)* A focused regional group of centers have combined in a proactive way to share data, analyze it in a constructive way, and offer suggestions and recommendations for change or improvement.

There is a word of caution regarding mandatory databases. Shahian et al[139] have nicely documented the evolution and initiation of a mandatory reporting system in Massachusetts. The major progressive element in this program is the statewide adoption of the Society of Thoracic Surgeons (STS) National Cardiac Database (NCD). Grun kemeier, et al[140] in commenting on the Massachusetts argue that the model entails both continuous quality improvement (CQI) which is proactive and progressive, and cardiac report cards which can be negative, and at times punitive. They applaud the well received Northern New England Cardiovascular Disease Study group model which is voluntary, and the participants controlling the data[141].

In summary, quality assur ance is shifting from quality improvement to performance or value improvement.

This becomes a pro-active movement that is less punitive and accusatory and more constructive. The joint commission on the accreditation of Healthcare Organizations (JCAHO), as well as the American College of Surgeons in collaboration with the National Surgical Quality Improvement Program have been notable examples of this improvement effort. It is interesting to compare a macro approach, i.e. JCAHO, and the micro approach, i.e. a clinical cardiathoracic surgery working in the trenches (Figure 29).

Figure 29 : Components of Quality Assurance/Performance

JCAHO[142]	V. A. Gaudiani[143]
- Accessibility of Care - Appropriateness of Care - Continuity of Care - Effectiveness of Care - Efficacy of Care - Efficiency of Care - Patient Perspective Issues - Safety of Care Environment - Timeliness of Care	- Patient Satisfaction - Institutional process - Outcomes - Appropriateness of care - Efficiency of resource management

The strategic/tactical top/down and the strategic bottom/up approaches are sur prisingly similar[142,143]. The strategic and tactical goals have thus been set. The basic tools are now available, and continue to evolve and improve. Application is the ongoing process, with the ultimate goal of making surgery and surgic al decisions safe and beneficial for the patients we treat and serve.

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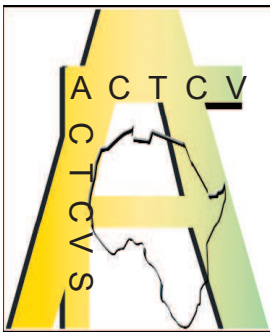

Chirurgie Cardiaque / Cardiac Surgery

THROMBOLYSIS FOR PROSTHETIC VALVE THROMBOSIS: A REPORT OF 6 CASES AND REVIEW OF THE LITERATURE.

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Summary

Objectives: To determine the outcome of thrombolysis in patients with Prosthetic valve thrombosis (PVT).
Design : A retrospective descriptive study.
Setting : The intensive care unit of the National Cardiothoracic centre, Korle-bu Teaching Hospital , Accra, Ghana.
Subjects: 5 consecutive patients who were thrombolysed for 6 episodes of prosthetic valve thrombosis.
Method: Over a 3-year period 5 patients underwent a total of 6 thrombolytic sessions. All the patients were symptomatic and diagnosis had been confirmed by echocardiography. Streptokinase was used in 5 of the sessions. 1.5 million International units (IU) was used in the adults and 750,000IU in the 13 year old. One patient had 2.0 IU of uroki nase. The inf usion was by the short course thrombolytic method over 90 Minutes.
Results: There were 6 episodes of thrombosis out of 142 (5.0%) valve replacements during the study period. The mean age was 29.5 + 11.2 years (range 13-48years). The time from insertion of prosthetic valve to thrombosis was 15.5 months (range 1 week – 2 years). The INR was sub-therapeutic in 5 (83 .3%) of the patients. Streptoki nase was used in 5 (83 .3%) and urokinase in 1 (16.7 %) of the patients. The overall success was 83.3%. Thombolysis was completely successful in 3 (50 .0%) and partially in 2 (33.3 %). There was no response to thrombolysis in one patient who died after 14 years.
Conclusion : Thrombolysis of prosthetic heart valves is not common from out series. Thrombolysis using streptokinase should be the first line management as it is cheap and relatively safe in the management of such cases.

Key words : Thrombosis - Thrombolysis - Prosthetic valve

Introduction

Prost hetic heart valve disease may be rarely complicated by thromboembolism, bleeding, endocarditis and valve dysfunction from pannus formation[1]. Of these thromboembolism of a mechanical prosthetic valve is the most serious as it leads to severe haemodynamic decompensation including shock and acute heart failure[1-3]. Thrombosis may also complicate pannus formation. Until recently the management of prosthetic valve thrombosis (PVT) was mainly by reoperation where a thrombectomy or replacement of the valve is done[2].
Re-operation is usually by cardiopulmonary bypass and because most of the patients are in i ntractable heart failure there is a high mortality[4-5]. Many workers have advocated thrombolysis as the first line management of PVT using the rapid inf usion or the slow infusion method[4-6]. The mortality of the PVT is related to the New York Heart Association (NYHA) class of heart failure at the time of presentation, with NYHA IV usually having a poor prognosis[6-7].
The intensive care unit of the Cardiothoracic Centre has for the past 3 years treated 5 patients who had 6 episodes of PVT. This study therefore looks at management of these cases as well the outcome in terms of morbidity and mortality.

Method

Using the intensive care, admissi ons and discharge register, the report books and the patients case notes, patients who had thrombolysis for prosthetic valve thrombosis between 1st January 2003 and 31st December 2006 were studied. The clinical presentation, NYHA Class of heart failure, the initial INR, and echocardiographic information were also looked for.

The patients were all thrombolysed in the intensive care unit of the Cardiothoracic Intensive Care unit. All the patients had invasive monitoring through a radial arterial and a central venous line. Inotropic support by dopamine and adrenaline infusions was started as part of the protocol for management of such cases. After pre- thrombolytic therapy of intravenous methyl-prednisolone 250mg and Promethazine 12.5mg, 5 patients were administered streptokinase and 1 urokinase. After a test dose of 20,000 IU units, each patient was administered 1.5 million units of streptokinase in the adults and 750,000 units in the adolescent. Two million units of urokinase was administered to one patient who had previously been administered streptokinase. All the thrombolytics were infused over a 90 minute period. Complete hemodynamic success was defined as return of the transvalvular gradient to normal. Partial success was defined as partial improvement in gradient without complete normalization of the valve movements. The data was analysed using SSPS (Microsoft 2003).

Results

There were 6 episodes of PVT in 5 patients out of a total of 142 valve replacements during the study period. The age range was 13-48 years (mean 29.5+11.2 years). There was a male to female ratio of 2:1. The mitral valve was involved in 5 (83. 3%) of the episodes with the aortic valve being involved in 1 episode. Five (83.3%) of the patients had sub-therapeutic INR. These are depicted in table 1 below. All the patients presented with pulmonary oedema, 3 (50. 0%) were hypotensive and 1 (16.7%) was in shock with multi-organ dysfunction. The mean time from insertion of the valve till thrombosis was 15.5+11.2 months with a range of 7 days to 24 months. Three (50.0%) of the patients were in NYHA IV and 3 (50.0%) in NYHA III.

Table 1 : Showing age, sex, age of valve, INR, clinical signs and NYHA class.

Age	Sex	Valve throboly-sied	Age of valve mouths	INR	Clinical signs of	NYHA Class
13	M	Mitral bileafleft	2	1,5	Pulmonary oedema	III
29	M	Mitral bileafleft	21	1,3	Pulmonary oedema Hypotension	II
29	M	Mitral bileafleft	24	1,7	Pulmonary oedema Hypotension	IV
31	F	Mitral bileafleft	22	1,2	Pulmonary oedema Hypotension	IV
27	F	Mitral bileafleft	24	2,0	Pulmonary oedema	III
48	M	Mitral bileafleft	0,25 (7 days)	1,5	Pulmonary oedema Shock Multi organ dys-function	IV

Streptokinase was used in 5 (83 .3%) of with urokinase in 1 (16. 7%) for thrombolysis.
Thrombolysis was successful in 3 (50.0 %) of the patients with a partial success in 2 (33.3%). The overall success rate was 83.3%.

The patients with partial success later had reoperation. The average time to improvement of haemodynamic signs was 4.4 + 2.2 hours with a range of 2-8 hours. These are seen in table 2.

Table 2 : Thrombolytic, time of improved function, success and outcome of thrombosis.

Valve thrombosed	Thrombolytic used	Times of improved function/ Hrs	Success of thrombolysis	INH A Class	Complications of thrombolysis	Outcome
Mitral	Streptokinase	2	Complete	III	Allergy Hypotension	Alive 3 years
Mitral	Streptokinase	6	Complete	III	Allergy	Re-thrombosed in 3 months
Mitral	Urokinase	8	Partial	IV	-	Re-operation died
Mitral	Streptokinase	5	Complete	IV	Allergy moderate moderate bleeding	alive 4 years
Aortia	Streptokinase	5	Partial	III	Allergy	Pannus re-operation alive
Mitral	Streptokinase	Did not improve	No response	IV	bleeding	Died after 14 hours

One of the patients who had a partial success from thrombolytic therapy from use of urokinase died during redo-surgery. The commonest complication was allergy (66.7 %) and this was from the use of streptokinase. The two patients who died were in NYHA class IV. Four of the patients who survived the management of their PVT are still alive 39-48 months after the thrombotic events.

Discussion

Prosthetic valve thrombosis though infrequent is usually dreaded by most physicians because of the severe haemodynamic complications. After PVT patients can present with hypotension, pulmonary oedema, embolic phenomenon or more seri ously cardiogenic shock[1-3]. The incidence of l eft si ded PVT is reported to be between 0.5 -8% but this increases to 20% in right sided valves especially in prosthetic tricuspid valves[7]. The institutional incidence of PVT in our study (5.0%) is within this range. Another study by Sivasubramanian who use the same Sorin bileaflet valves as our institution had an incidence of 6.7%[8]. Renzelli cited the most significant risk as tilting disc prostheses, prostheses without pyrocarbon coating, large prostheses, tilting disc prostheses with a small orifice posteriorly oriented, atrial fibrillation, enlarged left atrium and time from implant greater than 4 years[9]. The mitral valve from previous studies has been found to be more commonly involved in left sided PVT and this agrees with our finding of 83.3%[1,4-6]. The patient with the aortic valve had a cage-ball valve all the other patients had Sorin bileaflet valves. Rizzoli et al in their study

demonstrated that the relative risk of thrombosis was12 times higher for the tricuspid prosthesis and seven times higher for the mitral prosthesis[10]. Rizzoli and his colleague also showed that there was a 69% risk reduction if Sorin tilting valves were used and this risk reduced further to 83% with Sorin bileaflet valves, the common valve used in our institution.

Many studies have shown a correlation between PVT and sub-therapeutic INR. Most of the patients with PVT in reported studies had INR below 2.0[1,4-6]. Of the 6 episodes of PVT 5 (83.3 %) had INR less 2.0. The main cause of sub- therapeutic INR in these patients was noncompliance in the taking of their coumarin drugs. The patient with the aortic PVT who had an INR of 2.0 had in addition extensive pannus formation around and in the cavity of the valve. Pannus formation, in addition to having an obstructive effect may also predis pose to the formation of extensive thrombi which was present in this particul ar patient[10]. Other causes of thrombotic events are associated coagulation disorders including protein C, Protein S and antithrombin III deficiencies 11.

Kontos, while investigating the clinical signs of PVT list ed exertional dypnoea, from pulmonary oedema as one of the main features[2]. He indicated that the presence of shock usually indicated a poor prognosis during management. This finding has also been confirmed in other studies[1,4-5]. All the patients in the present study had pulmonary oedema at presentation. Although hypotension was present in 66.7% of the cases only one was in shock with multi - organ dysfunction. All the patients were in NYHA class III-IV at the time of presentation. Roudant et al in their study of 127 cases had 90% of their cases in NYHA III-IV[12]. It has been categorically proven that a NYHA class of III-IV is associated with a high mortality rate no matter the mode of management. However workers have advocated thrombolytic therapy for these groups of patients[12-13]. Thrombosis can occur if the administration of heparin is not done early. There was an early thrombosis in our study of 7 days postoperatively. The early thrombosis in this patient was because of sub-therapeutic heparin administration 24-28 hours postoperatively. Talwar and his colleagues in a study on causes of early valve thrombosis found out that 6.1% of their patients developed significant thrombosis in 9 days if heparin therapy was not aggressive enough while warfarin was sub-therapeutic which has been confirm ed by other workers[13-15]. Streptokinase (SK), urokinase (Uk) and tissue plasminogen activator (rTPA) have all been used for thrombolys is with relatively good result s[11-17]. Roudaut et al in their study found out that SK and rTPA were more effective than Uk for thrombolysis. The other factors that may affect the choice of thrombolytic would be, the side-effects of streptokinase, the non-availability of urokinase and the expense of rTPA[6,7,12,16,17]. Some workers have used the prolonged or short course infusion protocols for thombolysis depending on the haemodynamic condition of the patients. However there is no clear advantage of one protocol over the other in terms of resul ts and the protocol adopted may depend on individual or institutional preferences[6,12,14,16-18]. Our inst itution uses the short course protocol which is much cheaper than the prolonged course infusion technique.

The short course protocol has the advantage in that clinical improvement is seen early in the management of the cases. Thrombolytic therapy was however not repeated during the thrombotic episodes in our study. Studies have shown increased success rate with repeated doses or prolonged infusion of thrombolytics during a thrombotic episode[6,12,16-18]. Overall success rates of thrombolysis cited in the literature have been between 70-90% and these have been independent of the thrombolytic used[12,16-18]. Our success rate of 83.3% falls within range. The overall success rate increases with repeat thrombolysis or if continuous prolonged infusion of the thrombolytics is used. However thrombolysis in patients presenting in NYHA class III-IV is less successful than in patients in class I-II. It has become evident that transoesophageal echo-cardiography (TEE) has become invaluable in the diagnosis and the proper management of patients with PVT. The thrombus size is significant in the determination of the clinical outcome and the complications that occur during thrombolysis . A study by Tong and his colleagues gave the best cu-off area of thrombus for predicating complications as 0.8cm2 [7]. Many workers use TEE to follow the progress of thrombolysis in these patients and also to assess the success to thrombolysis[12,13,16-19]. Complications cited in the literature include embolic phenomenon, strokes, transient ischaemic attacks, bleeding and allergy especially to SK[2,12,14,16-18]. Complications during thrombolysis are more common in patients with shock, tachycardia, hypotension, previous stroke, extension of thrombus beyond the valve margins and the thrombus area[7]. Our study had a high proportion of allergy to SK (60%) because of the suspected high incidence of streptococcal sore throats in developing countries. Studies have given a complication rate of 12-24%[7,17]. Surprisingly there were no embolic phenomenon and also no strokes in our study. Strokes which are common in some studies are usually associated with small thrombus rather than large thrombi[7]. It is now evident that thrombolysis has a lower mortality for all classes of NYHA functional

class from PVT as compared to open heart surgery. The ACC/AHA current recommendations advice thrombolysis for most cases of PVT[19]. There is also a high mortality in patients presenting with PVT and shock. Gupta and his colleagues recorded a mortality of 78% of patients who presented with PVT and shock[17]. One patient in out study died during thrombolys is and his presentation was shock and multi organ dysfunction.

In conclusion, thrombosis of prosthetic heart valves is not common from out series. Thrombolysis using streptokinase should be the first line management as it is cheap and relatively safe in the management of such cases.

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Chirurgie Cardiaque / Cardiac Surgery

CHIRURGIE RECONSTRUCTRICE DE L'INSUFFISANCE MITRALE RHUMATISMALE DE L'ENFANT : TECHNIQUES ET RÉSULTATS A PROPOS DE 24 CAS OPÉRÉS A DAKAR.

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Résumé

Entre Octobre 1999 et Avril 2000, 24 mal ades âgés de 9 à 16 ans avaient bénéficié d'une valvuloplastie pour insuffisance mitrale.
Le but de ce travail est de rapporter cette premi èr e série en i nsistant sur les aspects techniques et les r ésultats immédiats du traitement. L'insuffisance mitrale était classée en 4 types selon la classification de fonctionnelle de Carpentier : type 1 (1 cas) caractérisé par une dil atation isolée de l 'anneau mitral ; type II (6 cas marqué par un prolapsus valvulaire ; type III (1 cas) défini par une restriction valvulaire et des dysfonctions mixtes (16 cas) associant l es types II et III. La réparation chirurgicale sous circulation extra-corporelle faisait appel à des techniques de chirurgie reconstructrice intéressant les différents éléments de l'appareil valvulai re mitral : anneau, tissu valvulaire, cordages et piliers. Dans 6 cas un geste associé avait été réalisé sur la valve tricuspide : plastie de De Vega (5 cas) et anneau de Carpentier (1 cas). La mortalité hospitalière était de 4 %. Le délai moyen de suivi était de 67 jours. Les examens échographiques post-opératoires avaient montré une fuite mitrale résiduelle modérée à importante chez 5 patients (33 % des cas) parmi lesquels 4 avaient une dysfonction mixte préopératoire avec des lésions sténo-ré tracti les plus ou moins importantes. Les résultats étaient satisfaisants chez 17 patients (77 % des cas) . Il n'y avait pas de complication thromboembolique ou infectieuse. La chirurgie réparatrice mitrale est certes une méthode d'exécution plus difficile que le remplacement valvulaire, mais ses avantages en font un traitement de choix chez l'enfant. L'amélioration de ses résultats passe par une meilleure sélection des malades.

Mot clés : Valvuloplastie mitrale - rhumatisme cardiaque – enfant.

Summary

Between October 1999 and April 2000, 24 patients aged from 9 to 16 year s under went valvuloplasty for rheumatic mitral valve regurgitation.
The aim of this study was to report our first serie, emphasizing on the technical aspects and the immediate results of the treatment. Mitral valve in competence were classified into 4 types according to Carpentier classification t ype 1 (1 case) is an isolated mitral annular dilatation, type II (6 cases) a mitral valve prolapse, type III (1 case) a restriction of leaflet motion, and mixed dysfunction (16 cases) with prolapsed and restricted leaflet motion. Mitral valve repair was performed under standard cardiopulmonary bypass by plastic surgical techniques at the four levels of the mitral apparatus : annular, valvular, chordac and papillary levels. In 6 patients mitral valve reconstruction was combined with tricuspid procedures by the De Vega plastic technique in 5 cases and by Carpentier ring in 1 case. The hospital mor al ity was 4,17 % (1 death). The mean follow up time was 67 days. Prostoperative echocardiographic examinations had shown residual mitral insufficiency moderate to important in 5 patients (33 %). Four among them had mixed dysfunction before surgery-

Key words : Mitral valvuloplasty - Cardiac rheumatism - Children

Introduction

Le traitement de l'insuffisance mitrale significative est avant tout chirurgical. Chez l'enfant et l'adolescent, le remplacement valvulaire cardiaque pose plusieurs problèmes liés à la croissance, à la détérioration précoce des bio-prothèses et aux contraintes du traitement anticoagulant qu'imposent les prothèses mécaniques[1].

C'est pourquoi, sur ce terrain, l'intervention doit autant que possible consister en une valvuloplastie reconstructive selon les techniques de Carpentier qui donnent de bons résultats[2,3]. De plus le coût élevé des prothèses valvulaires cardiaques plaide en faveur de la chirurgie reconstructive dans notre contexte de pays en développement où les cardiopathies valvulaires rhumatismales restent un problème de santé publique[3,4].

Le but de ce travail est de rapporter notre première série d'enfants ayant bénéficié d'une plastie mitrale en insistant sur les techniques de la réparation chirurgicale et les résultats immédiats du traitement.

Malades et Méthodes

Entre Octobre 1999 et Avril 2000, 24 malades ont bénéficié d'une chirurgie reconstructive pour insuffisance mitrale. Il s'agissait de 16 filles et 8 garçons (sex ratio = 0,5) suivis dans les Services de Cardiologie de l'Hôpital A. Le Dantec et de l'Hôpital Principal de Dakar pour insuffisance mitrale significative. Les principaux critères d'inclusion étaient l'âge et l'aspect échocardiographique des lésions mitrales: valves assez souples, appareils sous-valvulaires peu ou pas remaniés.

L'âge moyen des patients était de 12,5 ans (9 et 16 ans).

Tous les malades avaient des antécédents de rhumatisme articulaire aigu (RAA) documentés et dont le diagnostic a été fait selon les critères de Jones. Un patient était en poussée aigue rhumatismale.

Lors du bilan préopératoire, 19 patients étaient en classe fonctionnelle II ou III de la New York Heart Association (NYHA) et 5 patients en classe fonctionnelle I.

L'électrocardiographie montrait un rythme cardiaque sinusal chez tous les patients.

Le rapport cardio-thoracique radiographique moyen était de 0,60 (extrêmes : 0,54 et 0,72).

Six patients avaient une insuffisance tricuspide associée jugée significative, et 9 patients une pression artérielle pulmonaire systolique (PAPS) supérieure ou égale à 50 mm Hg. Deux patients présentaient une fuite aortique modérée associée.

L'Echocardiographie préopératoire et l'exploration chirurgicale avaient permis de classer les différents mécanismes responsables de la fuite mitrale selon la classification de Carpentier en tenant compte des lésions prédominantes : Un patient présentait une insuffisance de type I par dilation annulaire isolée. Six patients avaient une insuffisance mitrale de type II : Il s'agissait de prolapsus de la valve antérieure par élongation et/ou rupture de cordages. Un patient présentait une insuffisance mitrale de type III par limitation isolée des mouvements de la valve postérieure qui était rétractée et manquait d'étoffe. Seize patients avaient une dysfonction valvulaire mixte II-III associant prolapsus de la grande valve, rétraction de la petite valve et/ou fusion commissurale.

Toutes les interventions chirurgicales étaient effectuées de façon quasi-identique par la même équipe. Il s'agissait d'une chirurgie à coeur ouvert utilisant la circulation extra-corporelle entre l'aorte et les deux veines caves. La protection myocardique était assurée par décharge des cavités cardiaques, hypothermie générale modérée et cardioplégie froide aux cristalloïdes injectés toutes les 30 minutes. Après clampage aortique, la valve mitrale était abordée par atriotomie gauche par le sillon interatrial. Le temps de clampage moyen était de 75 minutes.

Pour les six patients qui présentaient une insuffisance tri-cuspide associée, la plastie tricuspide était effectuée à coeur battant après réparation mitrale et déclampage aortique. Les réparations valvulaires mitrales avaient consisté en plusieurs gestes parfois associés chez le même patient. Ainsi avaient été réalisées: une plastie de raccourcissement de cordages allongés par enfouissement dans le pilier correspondant ou par simple plicature dans 19 cas, une transposition de cordages pour cordages rompus ou allongés et fins dans 8 cas, une mobilisation valvulaire par résection de cordages secondaires, fenestration de cordages fusionnés, élargissement de la petite valve par patch de péricarde autologue ou commissurotomie dans 20 cas. L'insuffisance tricuspide significative chez 6 patients était traitée par plastie dans le même temps opératoire, dans 5 cas par la technique de De Vega et dans 1 cas par un anneau de Carpentier tricuspide. Les malades étaient remis sous antiprophylaxie à la Pénicilline retard à leur sortie de l'Hôpital. Leur suivi avait consisté à un examen clinique et échocardiographique. Dans l'évaluation des résultats, nous avons étudié la mortalité, le statut fonctionnel postopératoire et certaines complications classiques de la chirurgie valvulaire : les troubles du rythme et de la conduction cardiaques, les accidents thromboemboliques, les infections et les détériorations de la réparation valvulaire.

Résultats

La mortalité hospitalière a été de 4,17% (1/24 malade). Il s'agissait d'un malade décédé au deuxième jour postopératoire d'un bas débit cardiaque lié à une dysfonction du ventricule gauche. Ce patient était en classe fonctionnelle III de la NYHA préopératoire et avait eu une sortie de CEC difficile probablement liée à des embolies gazeuses coronaires.

Parmi les 23 survivants, 22 ont été revus. Un malade a été perdu de vue à sa sortie de l'Hôpital. Le délai moyen du suivi a été de 2 mois et 7 jours. Malgré ce faible recul, nous avions constaté une amélioration fonctionnelle chez 21 malades qui étaient revenus aux stades I ou II, ainsi qu'une baisse de l'index cardiothoracique moyen (de 0,60 à 0,55).

Un patient était en stade IV. Il présentait une insuffisance mitrale de type 111 de la classification de CARPENTIER

avec des lésions sténorétractiles mitrales peropératoires très évoluées et une fuite aortique modérée négligée.
Dix neuf malades avaient gardé leur rythme sinus al initial. Deux patients avaient présenté un bloc atrioventriculaire du 3ème degré résolutif chez l'un et persistant chez l'autre nécessitant une stimulation défmitive et un patient a présenté une tachycardie atriale bien tolérée sur le plan hémo-dynamique.
Aucune complication thromboembolique ou infectieuse postopératoire n'avait été relevée chez les 22 malades revus au cours du suivi.

Tableau I : Comparaison des paramètres cliniques et paracliniques pré et postopératoires.

Paramètres	Préopératoires : n %	Postopératoires : n %
masse fonctionnelle NHYA de I de I-II de II-III de IV	24 (100 %) 5 (20,84 %) - 19 (79,17 %) -	23 (100 %) 21 (95,45 %) 1 (4,35 %)
Rythme et conduction cardiaque	24 (100 %) - - - -	19 (86,36 %) 2 (9,09 %) 1 (4,55 %) 1 (4,55 %) 1 (4,55%)
Moyen radiologique	0,60	0,55
VG moyenne échographique	0,63	0,67

NYHA : New York Heart Association
ICT : Index Cardio- Thoracique
FEVG : Fraction d'éjection du ventricule gauche
** I malade perdu de vue après sa sortie de l'Hôpital*

Tableau II: Classification des lésions anatomique valvulaires mitrales.

Types lésionnels	Nombre	Pourcentage
Type I	1	4,17
Type II	6	25
Type III	1	4,17
Type IV (mixte)	16	66,66
Total	**24**	**100**

Les différents examens échocardiographiques avaient montré des résultats satisfaisants. Ainsi, la fraction d'éjection moyenne du ventricule gauche avait augmenté de 0,63 à 0,67. Chez 17 patients, il existait une fuite mitrale minime. Chez les 5 autres, l'insuffisance mitrale résiduelle était modérée à importante. Elle était associée à une insuffisance tricuspide significative avec des pressions pulmonaires élevées dans trois cas. Le seul patient qui était en stade fonctionnel IV de la NYHA avait en plus de l'insuffisance mitrotricuspide importante une fuite aortique significative et une importante dilatation des cavités cardiaques. Quatre des cinq malades qui présentaient une fuite mitrale résiduelle importante avaient une dysfonction mixte II/111 lors de la réparation associant prolapsus de la valve antérieure et des lésions sténo rétractiles plus ou moins importantes.

Discussion

L'atteinte mitrale est la plus fréquente des lésions valvulai res au cours de la cardite rhumatismale. Chez l'enfant, l'insuffisance mitrale qu'elle peut entraîner se caractérise par la rareté de la fibrillation atriale et de l'association d'une insuffisance tricuspide en raison du caractère peu évolué de la maladie[2,5]. Notre étude confirme ces particularités cliniques : Tous les malades étaient en rythme sinusal et l'insuffisance tricuspide n'était significative que dans 21 % des cas.
Sur le plan anatomique, le prolapsus de la valve antérieure était le mécanisme le plus fréquent de l'insuffisance mitrale, retrouvé dans 92% de nos cas. Dans l'insuffisance mitrale rhumatismale, sa prévalence varie selon les séries de 30 à 97 %[5,6,7]. Ce prolapsus, comme c'est le cas dans notre étude, est souvent dû à une élongation ou à une rupture de cordages. L'atteinte élective des cordages de la valve antérieure est assez caractéristique de l'étiologie rhumatismale. Dans les maladies dégénératives comme la maladie de Barlow, ce sont les cordages de la valve postérieure qui sont plus souvent atteints[8]. L'élongation et/ou la rupture des cordages de la valve antérieure ne sont en fait que la conséquence de la dilatation de l'anneau mitral qui serait la lésion initiale dans l'atteinte rhumatismale. Cette dilatation associée à une restriction des mouvements de la valve postérieure plus sujette à la fibrose inflammatoire exposeraient les cordages à une forte tension durant la systole ventriculaire[6,8]. Les cordages les plus exposés sont les cordages primaires paramédians de la valve antérieure. La réparation des élongations de cordages se fait par raccourcissement par simple plicature du cordage allongé, mieux par enfouissement dans le pilier, transposition de cordages ou utilisation de néocordages en polytétrafluoroétylène (PTFE)[6,9,10]. Il s'agit d'un des gestes les plus difficiles de cette chirurgie car l'appréciation de l'allongement reste très subjective[8]. D'une manière générale, les lésions multiples sont la règle dans les atteintes rhumatismales. C'est le cas dans notre série où le mécanisme de l'insuffisance mitrale était une dysfonction mixte dans la plupart des cas associant prolapsus de la valve antérieure, restriction de la petite valve avec parfois une fusion bicommissurale importante, dilatation et/ou déformation annulaire. C'est pourquoi toute reconstruction mitrale doit s'attacher à réparer l'ensemble des lésions rhumatismales qui peuvent toucher toutes les composantes de l'appareil valvulaire mitral: l'anneau,le voile et l'appareil sous-valvulaire[8,9].
La mise en place d'un anneau a été systématique chez tous nos malades. Cet anneau prothétique de Carpentier permet non seulement de réduire la taille de l'anneau natif, mais aussi d'assurer un remodelage de celui-ci et un

renforcement de la réparation, prévenant ainsi la dilatation secondaire[8,9]. Selon Antunes et al[8], il est préférable chez l'enfant d'utiliser un anneau rigide ou semi-rigide à cause de la perte des capacités contractiles de l' anneau natif qu'induit la maladie rhumatismale. L'utilisation d'un anneau flexible est plus appropriée dans les plasties mitrales sur lésions dégénératives chez l'adulte car l'anneau rigide peut être à l'origine d'une obstruction de la chambre de chasse du ventricule gauche[8].

La mortalité hospitalière dans notre série était de 4,17 %. Cette mortalité varie dans les différentes séries publiées entre 2,5 et 4,5%[7,11].

Nous avions observé 2 cas de bloc atrioventriculaire dont 1 résolutif. Cette complication est rapportée dans la chirurgie valvulaire mitrale[11,15]. Elle est liée à la proximité du tissu de conduction avec la partie interne de l'anneau. Les courbes actuarielles de survie montrent une survie de 84 à 90 % à 5 ans après plastie mitrale pour lésions rhumatismales[3,7]. Notre recul n'autorise pas une telle évaluation. Le principal problème des valvuloplasties mitrales chez l'enfant est celui de la durabilité à moyen et long termes. Les réparations mitrales sont plus durables chez l'adulte et sur lésions dégénératives. Chez l'enfant le taux de réopération varie entre 16 et 37%[1,12]. Ce pourcentage de malades réopérés après plastie mitrale chez l'enfant est nettement supérieur au taux de détérioration valvulaire des nouvelles générations de prothèses mécaniques[13,14]. Selon Grometza et al[12], 81% des réopérations après plasties mitrales chez l'enfant se font durant la première année postopératoire. L'indication d'une réopération a été posée chez un de nos malades en stade fonctionnel IV de la NYHA avec fuite résiduelle importante.

Les causes d'échec des valvuloplasties mitrales sur lésions rhumatismales sont variées. Il peut s'agir d'une mauvaise indication, d'une malfaçon chirurgicale ou d'une évolutivité de la maladie rhumatismale[7,12]. De plus, la présence de lésions sténorétractiles telles une fusion commissurale, des lésions rétractiles de la petite valve et de l'appareil sous-valvulaire, augmente ce risque d'échec. Il s'agit là de lésions plus évoluées faisant appel à des techniques plus complexes[1,15]. Quatre des cinq patients avec fuite résiduelle importante avaient ainsi une insuffisance mitrale par dysfonction mixte associant prolapsus de la valve antérieure et lésions restrictives assez évoluées.

Le grand avantage de la chirurgie reconstructrice mitrale sur les remplacements valvulaires est la faible incidence des complications thromboemboliques, hémorragiques ou infectieuses. Ces complications peuvent être potentiellement graves[3,16]. Nous n'avons noté aucune de ces complications chez les malades de notre série. De plus, cette technique moins onéreuse, est adaptée à notre contexte et offre aux enfants une meilleure qualité de vie.

Conclusion

La chirurgie reconstructrice mitrale est une méthode d'exécution plus difficile que le remplacement valvulaire surtout sur des lésions rhumatismales. Ses avantages en font une alternative intéressante chez des patients bien sélectionnés dans notre contexte de pays en développement et médicalement sous équipé. Les résultats immédiats semblent prometteurs. Une évaluation plus poussée et à long terme chez des patients bien sélectionnés est nécessaire pour confirmer ces premiers résultats.

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lining the trachea, both bronchi, prestenotic dilatation of the oesophagus and the oesophagus. and the trachea.

Fibreoptic oesophagoscopy showed a tight stricture at 24 cm. The scope could not go through it.
The patient had surgery after one week of antibiotic therapy. He had a right thoracotomy and exploration of the impacted denture. A mass of granulation tissue was found close to the level of the carina. The impacted denture (Fig 3.) was removed from this mass, leaving a stricture and a large defect in the oesophagus and a smaller defect in the trachea close to the carina. The defect in the trachea was closed primarily with a nonabsorbable suture. The structured oesophagus could not be repaired. Oesophagectomy, cervical oesophagostomy and feeding gastrostomy were carried out. Post operative recovery was uneventful. After eight weeks, restoration of the gastrointestinal continuity was achieved by retrostemal colon bypass. He is currently living a normallife and will be returning to complete his course in the university.

Acquired TEF has often been reported with 'button battery' ingestion when direct impaction in the oesophagus allows direct corrosion, pressure necrosis, perforation and fistula formation II. TEFs caused by endotracheal tube intubation depend on several factors including prolonged intubation, an irritating or abrasive tube and pressure exerted by the cuff. Pressures exceeding 30 mmHg can significantly reduce mucosal capillary circulation and result in tracheal stenosis[4]. Keeping endotracheal cuff pressures less than 25 mmHg is important in the prevention of TEF.
Foreign bodies in the oesophagus can be classified into four categories[12]. The first is the purposeful ingestion of a foreign body either in a child or psychiatric patient. The second is accidental ingestion of a foreign body usually in food. The third is the impaction of a foreign body in the presence of an obstructive pathology in the oesophagus. And the fourth, the so-called steak bouse syndrome, in which a bolus, usually meat, is obstructed at the distal end of the oesophagus.
The most common locations of foreign body lodgement are at three areas of normal physiologic oesophageal narrowing. The uppermost narrowing is located at the
entrance into the oesophagus and is caused by the cricopharyngeal muscle. It is the narrowest point. The middle narrowing is the result of an indentation of the anterior and left lateral oesophageal wall caused by the crossing of the left main stem bronchus and aortic arch. The lowermost narrowing of the oesophagus is at the hiatus of the diaphragm and is caused by the gastroesophageal sphincter mechanism.

The common initial signs ofTEF are a sudden cough associated with ingestion of fluids and solids (Ono's sign)[7,9]. The patient may also present with sputum mixed with food, recurrent pulmonary infections, weight loss and profound weakness[7]. Some reported cases also described persistent history of cough, noisy breathing, stridor and a recent history ofvomiting after feeds II. The case reported bad a long history of intermittent dysphagia, cough productive of offensive sputum associated with liquid and solid ingestion, dysphagia, odynophagia and weight loss. The weight loss was due to the dysphagia which became progressive a year before presentation. Patients intubated in the intensive care unit on intermittent positive ventilation for prolonged periods who develop TEF may present differently. Fitzpatrick et al described detection of an air leak through the nasogastric tube via an underwater seal in the expiratory phase[13]. Marked gaseous abdominal distension have been described[14]. Rampaul et al described a clinical sign in these patients with TEF called the «breathing bag» sign[15].
In patients diagnosed with TEF, a chest X-ray can be useful in revealing aspiration pneumonia[9]. The chest X-ray of the case presented did not show any radiological sign of infection. If aspiration pneumonia is diagnosed, it has to be treated before any major surgery is carried out. TEF is usually demonstrated by radiologic contrast study or by direct endoscopic visualization[4,7,8,14]. The imaging method of choice for the evaluation of a TEF is an oral contrast study[7]. Meglumine diatrizoate (Gastrografm) is used in

For TEF, the difficulty in the management results from the need to manage both the consequences of the oesophageal communication and those of the illness responsible for the fistula[1]. For patients on mechanical ventilation who developed TEF, a conservative approach is used until patient is weaned from the ventilator[4]. The cuffed endotracheal tube is placed distal to the fistula site in order to prevent reflux of gastric contents into the lungs. A tracheostomy tube is placed distally to the TEF if possible. The head of the bed is elevated and oral secretions frequently suctioned. A gastrostomy tube is placed to minimize gastroesophageal reflux, and feeding jejunostomy tube is placed to minimize the gastroesophageal reflux, and for nutritional purposes. If the patient is critically ill and defmitive surgery cannot be undertaken, oesophagealligation, creation of a high salivary fistula and feeding gastrostomy is carried out[4]. In a case report by Angel Luis et al, a conservative approach with temporary airway stenting was successful in stabilizing a patient with a large postintubation tracheal necrosis and weaning her from the ventilator. The fistula healed spontaneously and the stent was removed without complication[2].
There are various surgical options available in the initial management of TEF are almost always supportive and followed by definitive surgical correction[17]. Primary closure of the oesophageal and tracheal defect with or without interposition of muscle flaps has been reported[3,17,18,20]. Interposition of radial fascial free flaps has been used to

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Chirurgie Thoracique / Thoracic Surgery

RÉTENTION PROLONGÉE D'UN CORPS ÉTRANGER BRONCHIQUE CHEZ L' ENFANT. A PROPOS D UN CAS À LIBREVILLE.

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Résumé
Le but du travail était de ressortir les difficultés de prise en charge rencontrées chez un enfant de sexe masculin, âgé de 9 ans, porteur d'un corps étranger bronchique de type métallique, depuis 4 ans. Son extraction a nécessité une exérèse bilobaire droite devant l'étendue des lésions parenchymateuses pulmonaires. La thoracotomie s'était compliquée d'un pyothorax nécessitant une reprise chirurgicale. L'évolution a été par la suite favorable.

Mots clés: Corps étranger-Bronche-Thoracotomie-Pyothorax.

Summary
The aim of the study was to show the therapeutical difficulties found in a 9-year-old boy presenting a bronchial foreign body since 4 years. It's extraction needed a right bilobar resection in front of extension of pulmonary parenchymatous lesions. Thoracotomy was complicated by empyema, leading to a redo surgery. Evolution was favourable afterwards.

Key words : Foreign body-Bronchus-Thoracotomy-Empyema thoracis.

Introduction

L'arbre trachéobronchique a pour fonction principale de favoriser le passage de l'air de l'oropharynx vers le poumon. Sa disposition anatomique par rapport aux organes de voisinage telle esophage prédispose à des fausses routes observées particulièrement chez les enfants qui sont souvent victimes d'inhalations intrabronchiques de corps étrangers.
La présence d'un corps étranger au niveau des bronches est de diagnostic le plus souvent tardif dans nos milieux alors que cette pathologie engage la vie du patient en raison de son retentissement respiratoire.
Nous rapportons ici un cas de rétention prolongée d'un corps étranger bronchique observé chez un jeune enfant de sexe masculin, dans le Service de Chirurgie Thoracique et Vasculaire de la Fondation Jeanne Ebori à Libreville.
Le but de ce travail a été de ressortir les difficultés de la prise en charge et le pronostic de cette pathologie.

Observation

M.R. âgé de 9 ans, avait été admis dans Service de Chirurgie Thoracique et Vasculaire de la Fondation Jeanne Ebori , le 11/07/1995, pour corps étranger bronchique.

Le jeune patient en provenance de l'intérieur du pays, avait transité par le Service de Pédiatrie du Centre Hospitalier de Libreville où le diagnostic avait été posé.
A l'admission, il présentait une toux grasse et chronique. L'interrogatoire retrouvait une notion d'inhalation ancienne de 4 ans d'un corps étranger. La radiographie du thorax avait mis en évidence une opacité correspondant à une vis métallique au niveau du tronc des basales de la bronche lobaire inférieure (Fig.1 et 2).

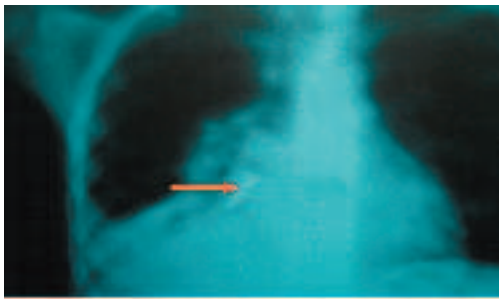

Fig 1 : Radiographie thoracique de face. Identification d'une vis métallique

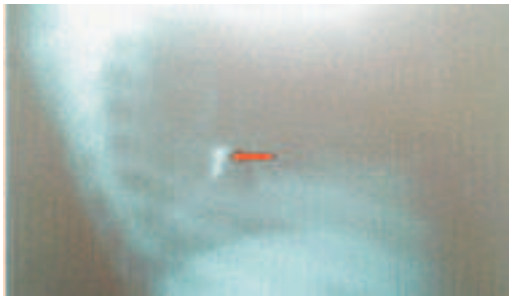

Fig 2 : Même image (flèche) vue sur une radiographie thoracique de profil

Des opacités au niveau du parenchyme pulmonaire correspondant associées à des images de surcharge hilaire étaient également visibles.
La bronchoscopie avait confirmé le diagnostic de corps étranger bronchique droit, mais n'avait pas pu permettre son extraction en dépit de plusieurs tentatives, Le corps étranger était englué dans des sécrétions mucopurulentes, et encastré dans une muqueuse bronchique inflammatoire.
Avant son transfert en chirurgie, une antibiothérapie avait été prescrite, Elle associait l'acide clavulanique à une aminoside.
L'indication d'une thoracotomie pour extraction du corps étranger avait été posée, Le bilan préopératoire avait retrouvé un syndrome biologique inflammatoire avec une hyperleucocytose, une vitesse de sédimentation accélérée et une anémie modérée (9,6 g/dl).
Une préparation à l'intervention chirurgicale avait été nécessaire. Elle associait une kinésithérapie respiratoire et des fluidifiants bronchiques à l'antibiothérapie en cours.
Le 02/08/1995, une thoracotomie droite fut réalisée. L'exploration peropératoire retrouvait une altération importante du parenchyme pulmonaire au niveau des lobes moyen et inférieur. Ces lobes étaient exclus du circuit ventilatoire, hépatisés et remaniés par l'atélectasie chronique, la stase bronchique et les infections à répétition. Une bilobectomie moyenne et inférieure était réalisée. L'examen de la pièce d'exérèse retrouvait une vis longue de 1 cm environ, d'aspect rouillé, engainée dans des mucosérosités. Le test d'étanchéité après suture bronchique était satisfaisant. La fermeture du thorax était faite sur un drain double de Toty.
En postopératoire immédiat, le patient avait été admis en Soins intensifs. Le protocole de réanimation associait une antibiothérapie, un apport hydro-électrolytique et une oxygénothérapie. La température, les drains (quantité, coloration) et la douleur étaient les éléments de surveillance clinique. Sur le plan paraclinique, la radiographie du thorax et la numération formule sanguine étaient réalisées quotidiennement.
Au 6è jour post-opératoire, le patient présentait un tableau infectieux respiratoire, avec une hyperthermie à 38,5°C et un aspect suppuré du liquide de drainage. La radiographie du thorax de face mettait en évidence un pyothorax. Une thoracotomie itérative fut décidée puis réalisée le même jour, pour nettoyer la cavité pleurale.
Au 2è jour, le syndrome infectieux avec hyperthermie à 38,5°C persistait. L'antibiothérapie fut modifiée, associant Omidazole et Céfuroxime. Une kinésithérapie respiratoire active permettait de lever l'encombrement bronchique. A J15 post-reprise, l'état du patient était notablement amélioré.
A J20, le contrôle radiographique était satisfaisant, en dehors de la présence d'une pachypleurite séquellaire (Fig.3), et la sortie fut autorisée.

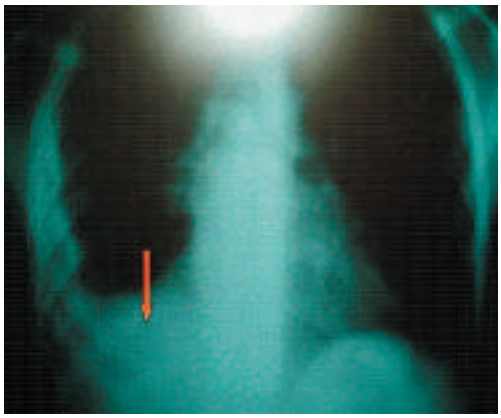

Fig 3 : Radiographie thoracique de face. Pachypleurite séquellaire (flèche)

Discussion

L'inhalation bronchique d'un corps étranger engage le pronostic vital du patient. Il s'agit d'une pathologie grave. L'inhalation d'un corps étranger est un accident qui peut affecter aussi bien l'enfant que l'adulte au regard de la littérature médicale. Certains auteurs donnent la prédominance de cet accident au sexe masculin[1]. A ce sujet, nous ne pouvons qu'observer que le seul cas rapporté ici est de sexe masculin.
Notre patient était âgé de 4 ans. C'est quasi l'âge moyen rapporté dans la littérature[2]. A cet âge, l'attention des parents est souvent dépassée par la tendance des enfants à mettre à la bouche tout ce qui est à la portée de leurs mains. La consistance du corps étranger inhalé est variable. Dans notre cas, il était de consistance dure comme dans la plupart des cas observés par Viot et al[2] dans leurs publications. La présence d'une vis métallique, comme dans notre observation, est tout de même exceptionnelle.
Les symptômes évocateurs sont d'origine respiratoire. Leur nature est fonction du délai entre le moment de l'inhalation où les symptômes sont ceux du syndrome de pénétration (quintes de toux sèche, accès de suffocation) et celui du diagnostic où les symptômes sont chroniques (toux grasse,

surinfections pulmonaires à répétition). Le diagnostic chez notre patient ne s'est pas fait au stade précoce comme dans l'observation décrite par Mohamed et al[3] à Bamako. Boussetta et al[4] soulignent eux aussi ce retard habituel du diagnostic au stade précoce. Ils l'expliquent par la négligence du tableau clinique de Syndrome d'inhalation, qui est souvent passager. En effet Les symptômes sont peu intenses et peu marqués au début .En plus, l'âge jeune du patient, l'absence de notion d'inhalation à l'interrogatoire, l'insuffisance de cet interrogatoire et le manque de possibilité de réaliser une radiographie du thorax, allongent le délai diagnostique. Dans notre cas, il faut ajouter à ces facteurs, celui du lieu de résidence primaire du patient. Ce dernier habitait en zone rurale, loin d'une structure sanitaire permettant une exploration radiographique qui aurait permis de faire rapidement le diagnostic. La conjugaison de ces facteurs justifie le passage à la chronicité, la fixation endobronchique du corps étranger, et l'installation des lésions broncho-pulmonaires.

La radiographie du thorax est essentielle au diagnostic. La possibilité de visualiser un corps étranger bronchique sur la radiographie varie cependant en fonction de sa localisation, sa nature, sa consistance, son aspect et sa taille. Dans notre cas, l'aspect métallique de la vis ainsi que sa taille ont facilité sa mise en évidence. Par ailleurs, l'image radiographique peut présenter différents aspects à type d'opacité, de syndrome obstructif et d'atélectasie[4]. Tous ces aspects sont présents chez notre patient. Ils traduisent l'atteinte du parenchyme pulmonaire et correspondent aux troubles de la ventilation, et à leurs conséquences évolutives. L'importance et l'étendue des lésions parenchymateuses sont fonction de la forme de l'objet inhalé, de sa taille, de sa topographie et de son niveau de fixation intrabronchique. En effet, plus cette forme est ronde et de petite taille, loin il ira dans sa migration intrabronchique et plus localisés seront les dégâts parenchymateux. Les corps étrangers plus volumineux et de forme moins arrondie ont tendance à se fixer plus haut dans l'arbre trachéo-bronchique. Ils entraînent de ce fait des dégâts parenchymateux plus étendus, comme c'est le cas chez notre patient.

La bronchoscopie peut aider au diagnostic, et surtout lors que la radiographie thoracique est muette devant une suspicion clinique d'inhalation bronchique[5]. Cependant, une bronchoscopie négative n'élimine pas le diagnostic[6]. Elle peut constituer également un moyen thérapeutique permettant l'extraction du corps étranger bronchique. Elle nécessite pour cela une technique assez rigoureuse exigeant une collaboration entre l'Endoscopiste et l' Anesthésiste, puisqu'elle se fait sous anesthésie générale.

Par ailleurs, elle exige un plateau technique adapté. Ce moyen thérapeutique n'a pas été indiqué chez notre patient, en raison du long délai d'évolution du tableau clinique conflrmé par les images radiographiques d'atteintes parenchymateuses étendues. La littérature rapporte un taux d'échec élevé de cette technique[7].

Notre patient a bénéficié de la chirurgie. Cette chirurgie, de façon générale peut être radicale ou conservatrice. Lorsqu'elle est radicale, elle expose de façon très significative à moins de complications à type d'atélectasie par rapport au traitement conservateur[8]. Une thoracotomie pour exérèse telle que réalisée chez notre patient, est ce que recommandent Sisenda et al[9]. Les suites opératoires sont généralement simples, même si un pyothorax a compliqué l'évolution dans notre cas.

Nous pensons comme d'autres auteurs[10] qu'une fibroscopie bronchique à visée diagnostique est indispensable en cas de suspicion de corps étranger bronchique même si le bilan clinique et radiologique est normal. C'est le moyen d'éviter la rétention prolongée, et l'installation des lésions parenchymateuses pulmonaires.

Conclusion

Le corps étranger intrabronchique est une pathologie respiratoire grave chez l'enfant. Sa mortalité n'est pas négligeable en raison du diagnostic souvent tardif par négligence de la symptomatologie inaugurale et de la chronicité du tableau clinique. Cette chronicité entraîne des lésions parenchymateuses souvent irréversibles, nécessitant une chirurgie d'exérèse, comme dans cette observation. Le diagonstic peut être difficile et expliquer les longs délaisJe rétention chronique. Dans le cas de ce patient, il est de retention chronique. Dans le cas de ce patient, il est facilité par la nature métallique du corps étranger. Son évolution relève de l'absence et de la difficulté à accéder à une structure de prise en charge spécialisée.

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Chirurgie Vasculaire / Vascular Surgery

CHIRURGIE DES ANÉVRYSMES DE L'AORTE ABDOMINALE SOUS RÉNALE À DAKAR.

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Résumé

Introduction : Les anévrismes de l'aorte abdominale (AAA) sous rénale, ont une incidence grandissante du fait du vieillissement de la population et de la fréquence des facteurs de risque vasculaire. Notre étude avait pour but de déterminer les aspects cliniques et anatomiques, d'évaluer la prise en charge chirurgicale à Dakar.

Malades et méthode : Cette étude rétrospective, à la clinique chirurgicale et au service de chirurgie thoracique et cardio-vasculaire, intéressaient les opérés pour anévrismes de l'aorte abdominale sous rénale, sur 12 ans (Mars 1994 - Mars 2006).

L'âge moyen était de 64 ans (37- 75 ans), avec un sex-ra tio de 0,6 (10 F et 6 M). Les circonstances du diagnostic étaient une masse vasculaire abdominale (50%), une douleur abdominale (43,75%). Dans 25% des cas, la découverte était fortuite lors d'une échographie, et rarement par une claudication intermittente, une constipation, ou une laparotomie pour suspicion d'appendicite. Un cas de rupture était noté. Les étiologies étaient dominées par l'athérosclérose (75%). La taille de l'anévrysme était de 66 mm en moyenne (50-96 mm). La mise à plat de l'anévrysme était suivie d'une greffe d'une prothèse aorto-aortique dans 5 cas (31%), aorto-bi-iliaque dans 7 cas (44%), aorto-bi-fémorale dans 3 cas (19%) et ilio-iliaque dans 1 cas (6%).

Résultats : La mortalité était de 12,5% (2 cas). Les complications précoces étaient : la poussée hypertensive dans 4 cas (25%), et un cas de thrombose artérielle iliaque. Les complications tardives étaient : un hématome para-prothétique, une rupture d'un anévrisme anastomotique, une occlusion sur bri des. Les suites opératoires étaient simples chez 12 patients (75%). Après un suivi moyen de 5 ans 8 mois, la survie était à 68,75%.

Conclusion : L'anévrysme de l'aorte sous rénale est une pathologie du sujet âgé de sexe féminin. Elle est rare. Son traitement relève exclusivement de la chirurgie classique au Sénégal avec des résultats acceptables. Ailleurs la chirurgie endo-vasculaire constitue une option complémentaire.

Mots clés : anévrysme Aorte abdominale - Afrique - chirurgie.

Summary

Introduction : Poor infrastructures and anesthesia is related to low surgical performance in developing countries. Because of increasing life expectancy, Abdominal aortic aneurisms are more diagnosed. We report the clinical anatomic and surgical outcome of the first cases operated in Senegal.

Patients and methods : This retrospective study reports the patients operated on between march 1994 and March 2006 for Abdominal Aortic Aneurism in the cardiovascular Surgery department of the University Hospitals in Dakar.

Mean Age was 64 years (37- 75 year s), and sex-ratio was 0.6 (10 F; 6 M). The diagnosis of abdominal aneurism was made after the discovery of an abdominal mass (50% of cases), abdominal Pain was also noted (43.7%) and in 25% of patients the aneurysm was asymptomatic and discover ed by echotomography, or claudicating or digestive symptoms and duri ng laparotomy. T here w as
one case of ruptured aneurysm. Atherosclerosis was the main etiology (75%). The mean diameter of the aneurysm measured by TDM was 66 mm (50-96 mm). All the patients were operated by open surgery and a prosthesis inserted. It was aorto aortic in 5 cases (31%), aorto bi -iliac in 7 cases (44%), Aorto bifemoral in 3 cases (19%) and illio iliac in 1 case (6%).

results : Mortality rates was 12.5 % (2 cases). Post operative complications were mostly : hypertensive crisis in 4 cases (25 %), illiac artery dissection and thrombosis, and para-prothetic haematoma. Complications during follow up were rupture of an anatomic aneuvrysm, and intestinal occlusion by adhesions. After a mean follow up time of 5 years and 8 months, 11 patients were alive in gfood condition.

Conclusion : Abdominal Aortic aneuvrysms are rare and patients amre mostly female in Senegal. Surgery can be offered to patient with a reasonnable risk. Open surgery i still the only one choice of endovascular techniques.

Key words : Abdominal Aortic aneuvrym - Surgery - Africa

Introduction

Un anévrysme de l'aorte abdominale (AAA) est défini comme une perte de parallélisme des parois aortiques; une dilatation permanente avec augmentation du diamètre de l'aorte de plus de 5 cm. Les petits anévrysmes ont un diamètre compris entre 4 et 5 cm. L'anévrysme de l'aorte abdominale sous-rénale se situe entre l'origine des artères rénales en haut et la bifurcation aorto-iliaque en bas sur le segment V de l'aorte[1].

Les patients porteurs d'un AAA meurent le plus souvent de rupture aortique. Comme on dispose d'une chirurgie préventive efficace, les chirurgiens n'ont cessé de prôner la nécessité d'opérer électivement les AAA[2].

Notre étude a pour but de déterminer les aspects topographiques et cliniques des AAA et d'évaluer leur prise en charge chirurgicale au CHU de Dakar.

Malades et Méthodes

Il s'agit d'une étude rétrospective, descriptive, longitudinale, portant sur 16 malades qui ont été recrutés sur une période de 12 ans (mars 1994- mars 2006).

Nous avons pris en compte: l'âge, le sexe, le terrain (existence ou non de facteurs de risques vasculaires), les circonstances de découverte, l'imagerie, l'étiologie retenue, les données du bilan préopératoire, la chirurgie (l'abord, les données de l'exploration, la technique opératoire, le type de prothèse utilisé, les complications per-opératoires, les complications postopératoires, le suivi).

L'étude s'est déroulée à Dakar, à la Clinique Chirurgicale de l'Hôpital Aristide Le Dantec et au Service de Chirurgie Thoracique et Cardio-vasculaire du CHU national de Fann. Les patients ont séjourné successivement en réanimation et en secteur d'hospitalisation.

Ont été exclus les patients ayant une extension sus-rénale et thoracique de l'anévrysme aortique, chez qui il fallait un clampage aortique isolant des organes nobles, et les patients récusés pour la chirurgie. Ainsi, nous avons exclu un patient qui présentait une infection au VIH au stade d'infections opportunistes sans traitement anti-rétroviral.

L'âge moyen des patients était de 64 ans et les extrêmes de 37 et 75 ans.

Le sexe féminin était prédominant, avec un sex-ratio de 0,6 (10 femmes et 6 hommes).

Douze patients étaient sénégalais et les autres venaient de la sous région ouest africaine: 3 guinéens et 1 mauritanien.

Sur le plan clinique les circonstances de découverte de l'anévrysme étaient variées (Tableau I) .

Une masse abdominale était retrouvée chez 8 patients.

Elle avait augmenté progressivement de volume, était battante et soufflante avec un signe de DE BAKEY positif; une douleur abdominale, isolée ou associée à d'autres signes, était notée chez 7 patients.

Tableau I : Fréquence des différentes circonstances de découverte

Circonstances de découverte	Nombre	Pourcentage
Masse	8	50
Douleur	7	43,75
Claudication intermittente	4	25
Echographie	4	25
Laparotomie	1	6,25
Constipation	1	6,25
Rectorragie	1	6,25
Anévrysme fémoral	1	6,25
Paresthésies	1	6,25
Choc-collapsus	1	6,25

Une claudication intermittente était notée chez 4 patients et 1 malade présentait des paresthésies des membres inférieurs. D'autres signes cliniques étaient retrouvés: constipation, rectorragies .(Tableau II) .

Tableau II : Etiologies des anévrismes

- Infectieux	**3**
oTuberculeux	1
oTyphique	1
oGerme inconnu	1
- **Inflammatoire**	**1**
o Douleurs, adherences , inflammation	
-Athérosclérose	**12**

Chez 1 patient, la rupture d'anévrysme de l'aorte abdominale a été la circonstance de découverte, avec des signes de choc, un collapsus cardio-vasculaire, un abdomen ballonné et des signes d'irritation péritonéale. Après une réanimation énergique, l'échographie avait permis de confirmer le diagnostic et l'exploration chirurgicale en urgence avait pu être effectuée. Chez 1 autre patient, l'exploration chirurgicale pour suspicion d'appendicite aiguë, avait retrouvé une masse rétro-péritonéale et secondairement les examens échographique et scannographique avaient permis de poser le diagnostic d' AAA sous-rénale.

Chez 4 patients, la découverte de l'anévrysme avait été fortuite lors d'une échographie abdominale dans le cadre d'un bilan.

L'échographie abdominale avait été réalisée chez 13 malades, la tomodensitométrie chez 14 patients.

Un seul patient avait bénéficié d'une artériographie. Cette imagerie médicale a permis de déterminer les différents aspects des anévrysmes de l'aorte abdominale sous rénale.

La taille de l'anévrysme, mesurée au scanner, était en moyenne de 66,35mm avec des extrêmes de 50 et 96 mm.

Il s'agissait chez tous les patients d'un anévrysme vrai

de l'aorte sous rénale, avec une ectasie du vaisseau. Le sac anévrysmal comportait toujours un thrombus de taille variable, qui réduisait la lumière artérielle. Des calcifications pariétales étaient retrouvées chez 9 patients (figure 1).

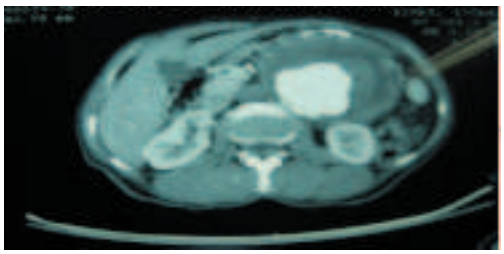

Fig 1 : Calcifications pariétales + thrombus au scanner

Une compression urétérale était notée avec une dilatation pyélique chez I patient. Les lesions associées suivantes avaient été retrouvées: kystes rénaux isolés chez 4 patients, dolicho-artère mésentérique supérieure chez 1 patient et une artère polaire rénale chez 1 autre.

La recherche étiologique s'intéressait d'abord à l'identification des facteurs de risque de l'athérosclérose, complétée par un bilan inflammatoire, et selon l'orientation, nous avons procédé à la sérologie syphilitique, et au bilan tuberculeux.

La principale cause de l'anévrysme aortique sous rénal chez nos malades était l'athérosclérose, qui était notée chez 12 patients. La conflrtnation anatomopathologique avait été faite chez 5 patients.

Un anévrysme infectieux était retrouvé chez 3 patients. L'origine tuberculeuse était retenue chez 1 patient qui avait des antécédents de bronchorrhée et de toux chronique non traitée. Le scanner montrait un odème pariétal de l'anévrisme et des zones de nécrose. L'exploration chirurgicale retrouvait du caséum dans la poche anévrysmale et l'examen bactériologique de la boue anévrysmale avait permis d'isoler le bacille de Koch. L'origine typhique était retenue chez un patient, qui avait présenté quinze jours auparavant une gonarthrite avec isolement de Salmonella typhi dans le liquide de ponction. L'examen de la boue anévrysmale avait permis également d'isoler le germe. Chez le troisième patient, aucun germe n'avait été isolé. Cependant, l'origine infectieuse était retenue devant le jeune âge (37 ans), la localisation multiple (il avait été opéré d'un anévrysme fémoral superficiel trois semaines auparavant), l'existence d'un syndrome inflammatoire avec CRP positive, une hyperleucocytose, l'existence d'un syndrome infectieux résolutif sous antibiothérapie, les aspects d'oedème pariétal et de nécrose observés sur le scanner.

La troisième étiologie rencontrée était l'anévrysme inflammatoire observé chez un patient qui présentait un syndrome inflammatoire associé à des douleurs abdominales. La découverte à l'exploration chirurgicale d'une gangue inflammatoire, avec de multiples adhérences entre la coque et les organes de voisinage avait conflrmé le diagnostic. Tous les malades avaient été opérés. La voie d'abord était systématiquement une laparotomie médiane xypho-pubienne. La désinsertion du ligament de Treitz permettait l'accès à la région rétro péritonéale. Ainsi les différentes caractéristiques de l'aorte étaient appréciées, de même que les organes de voisinage. Chez tous les malades, l'ectasie de l'aorte était conflrmée, ainsi que la topographie sous rénale, qui permettait ainsi un clampage d'amont plus aisé. Un seul patient présentait une rupture de l'anévrysme. Il s'agissait d'une rupture dans la région rétro-péritonéale, avec une fissure au niveau du versant latéral gauche du chenal, et un hématome diffus se prolongeant au niveau du psoas.

Un patient présentait des signes d'AAA sous-rénale inflammatoire, avec de multiples adhérences, et une gangue inflammatoire. Ces adhérences se faisaient avec le duodénum, les anses grêles, et la veine cave inférieure.

Pour tous les autres, il n'y avait pas de caractéristique spécifique en dehors de la morphologie. L'anévrysme était strictement localisé à l'aorte chez 5 patients. Chez les 11 autres, il s'étendait aux artères iliaques primitives (figure 2).

Fig 2 : Anévrysmes aortique et iliaque droite athéromateux

Après le clampage en amont et en aval de l'anévrysme, l'ouverture longitudinale de la paroi antérieure de l'anévrisme permettait d'évacuer dans tous les cas, un thrombus qui rétrécissait considérablement la lumière aortique (figure 3).

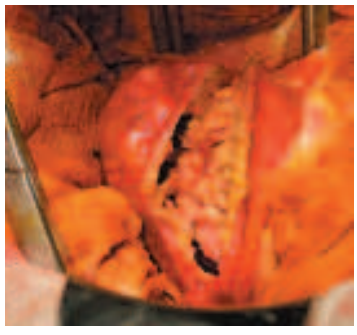

Fig 3 : Mise à plat de l'anévrysme entre 2 clamps montrant un volumineux thrombus

L'implantation d'une prothèse était systématique (figure 4).

Fig 4 : Prothèse aorto-iliaque implantée avec parois de l'anévrysme en place

Elle respectait l'intégrité de la paroi postérieure de l'anévrysme qui servait pour l'amarrage de la prothèse. Un seul patient n'avait pas eu de prothèse aortique. Il avait bénéficié après une plastie de l'aorte basse avec exclusion de l'iliaque primitive droite, d'une prothèse ilio-iliaque croisée. La prothèse mise en place était en dacron dans II cas, et en poly-tétra-fluoro-éthylène (PTFE) dans 5 cas. La taille de la prothèse aortique variait entre 16 et 22 mm avec une moyenne de 19,8 mm. Chez 5 patients, il s'agissait d'un tube aortique. En outre, 7 prothèses aorto-bi-iliaques avaient été posées, 3 aorto-bi-fémorales et 1 ilio-iliaque (figure 5).

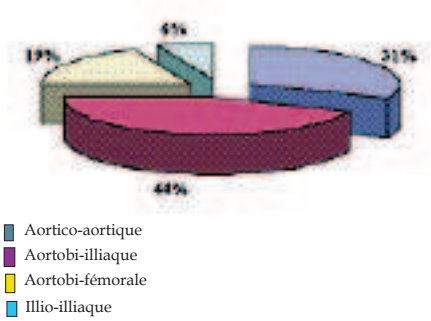

Fig. 5 : Répartition des prothèses utilisées

La durée du clarnpage aortique était en moyenne de 70 mn (45mn à 90mn). La durée moyenne d'hospitalisation était de 17 jours (4-29 jours) avec un séjour moyen en réanimation de six jours (2-29 jours).

Résultats

Aucun cas de décès peropératoire n'a été noté.
Un patient avait présenté une Hypotension artérielle après le déclampage aortique, qui avait été jugulée par l'administration d'éphédrine et le remplissage. La seconde complication per-opératoire notée, était une fibrillation ventriculaire avec arrêt cardiaque due à la traction sur les anses intestinales. La reprise de l'activité cardiaque en rythme sinusal avait été obtenue après massage cardiaque et défibrillation par un choc électrique.
Les pertes sanguines étaient en moyenne de 1200 ml, avec une transfusion sanguine moyenne de 1000 ml. La mortalité hospitalière était de 12,5% (n=2). Un patient est décédé au quatrième jour post-opératoire par arrêt cardiaque sans cause déterminée. Le second est mort d'une embolie pulmonaire massive au quatorzième jour malgré un traitement anticoagulant à dose curative. Des complications précoces étaient notées (Tableau III).
Elles étaient dominées par une crise d' hypertension artérielle chez 4 malades, et une thrombose artérielle iliaque précoce ayant nécessitée une thrombectomie, quelques heures après l'intervention. Toutes les complications précoces avaient évolué favorablement sous traitement.
Les complications tardives étaient les suivantes : un hématome péri prothétique associé a un hématome pariétal abdominal, causé par le traitement anti-coagulant est survenue, entre J24 et J36.

Tableau III : Fréquence des différentes complications précoces

Complications	Nombre	Pourcentage
Poussée hypertensive	4	25 %
Arrêt cardiaque	2	12,5 %
Troubles respiratoires	2	12,5 %
thrombose illiaque	1	6,25 %
Dysfonction érectile transitoire	1	6,25 %
Diabète insipide	1	6,25 %
Syndrome palustre	1	6,25 %

Elles étaient dominées par une crise d' hypertension artérielle chez 4 malades, et une thrombose artérielle iliaque précoce ayant nécessitée une thrombectomie, quelques heures après l'intervention. Toutes les complications précoces avaient évolué favorablement sous traitement.
Les complications tardives étaient les suivantes : un hématome péri prothétique associé a un hématome pariétal abdominal, causé par le traitement anti-coagulant est survenue, entre J24 et J36. L'évolution était favorable après arrêt du traitement anticoagulant, incision sous anesthésie locale de l'hématome pariétal suivie d'un drainage par une lame de Delbet ; Une rupture d'un anévrysme anastomotique infectieux à J48, ayant entraîné la mort avant la réintervention ; Une occlusion intestinale aigu par brides intestinales et éventration para ombilicale, survenue six mois après la cure de l'anévrysme. La patiente est décédée trois jours après la ré intervention dans une autre structure hospitalière. Les suites opératoires étaient favorables chez 12 patients. Le recul moyen était de 5 ans et 8 mois (2 mois-12 ans), avec une mortalité cumulée de 31,25% (n=5). Les trois décès secondaires étaient dus à: une rupture d'un anévrysme anastomotique à J48 ; une occlusion sur brides au 5e mois et un décès à domicile, de cause indéterminée.

Discussion

L'anévrysme de l'aorte abdominale est une pathologie du sujet âgé. L'age moyen dans notre série (64 ans) est avancé. Et pourtant il l'est beaucoup plus dans les séries occidentales, où il se situe autour de 70 ans[2,3].

La prépondérance masculine très marquée, classiquement décrite[1,4] n'est pas confmnée dans notre série où le sexe féminin prédomine.

Le plus souvent l'AAA sous rénale est de découverte fortuite, lors d'un examen paraclinique[1]. L'échographie nous a permis ainsi de faire souvent le diagnostic. Cette pathologie peut être symptomatique avec survenue d'une douleur abdominale (43,75%). En dehors des anévrysmes inflammatoires où elle est constante, la douleur marque un tournant dans l'évolution. Elle signe une fissuration ou une compression importante, et fait craindre ainsi une rupture. Cette rupture est une circonstance de découverte[5]. Nous en avons rencontré un cas. Du fait de son pronostic sévère, sa découverte est souvent faite à l'autopsie[2].

La contribution de l'imagerie est importante pour le diagnostic[4]. L'échographie permet le diagnostic, mais l'angio-scanner est plus sensible, en donnant la taille de l'aorte, la hauteur du chenal, la présence de thrombus (100% dans notre série), la topographie de l'anévrysme, les malformations des organes de voisinage que nous avons rarement retrouvé chez nos malades.

Les étiologies des AAA sous-rénale sont dominées par l'athérosclérose[1,6], qui affecte les sujets âgés. Les causes plus rares, sont dominées par l'infection que nous retrouvons chez 18,75% des patients. Elle est due à la tuberculose et à la salmonellose ces étiologies ont été déjà décrites dans la littérature[1,6]. Il s'agit d'une localisation secondaire, faisant suite, quelques jours plus tard, à une infection évidente non ou mal prise en charge[7]. Les étiologies inflammatoires sont beaucoup plus rares, avec une physiopathologie encore très discutée. Nous en avons rencontré 1 cas avec, comme décrite classiquement, une symptomatologie bruyante marquée par une douleur vive, un syndrome inflammatoire biologique.

Comme nous l'avons adopté systématiquement, la voie d'abord est le plus souvent une laparotomie médiane transpéritonéale[6,8]. Indiquée en chirurgie d'urgence, elle donne également en chirurgie réglée, un meilleur jour, et constitue la voie la mieux maîtrisée.

Cependant certaines équipes procèdent à des abords rétro-péritonéaux dans le but d'être moins invasif. Mais aucune amélioration notable n'est obtenue sur la morbidité[8,9,10].

La présentation topographique et morphologique de l'anévrysme est très variable. L'anévrysme sous-rérial s'étend souvent à l'une ou aux deux artères iliaques primi tives[11], qui sont souvent calcifiées et tortueuses pour les anévrysmes de grande taille. La rupture entraîne un épan chement sanguin péritonéal important, avec un hématome de la région rétro péritonéale qui diffuse à travers le psoas comme nous l'avons rencontré. Cette présentation rend difficile et urgent l'acte opératoire[12].

Chez nos patients l'artère mésentérique inférieure était hypotrophique ou thrombosée, et incluse dans la coque anévrismale, et n'a pas pu être réimplantée. Les adhérences importantes et gênantes dans l'anévrysme inflammatoire[13] n'ont pas permis pour notre cas, un remplacement de l'aorte mais plutôt une exclusion après remodelage suivi par un pontage extra anatomique.

Les complications post opératoires des AAA sous rénaux sont multiples. Les complications cardiaques sont fréquentes[6]. Elles ont été fatales pour un de nos patients. Ceci justifie le bilan cardiaque complet qui doit être effectué avant la chirurgie de l'AAA. Dans la littérature[14] les complications pulmonaires représentent 10 à 15%. Elles étaient à type de détresse respiratoire et d'odème aigu du poumon chez un de nos patients qui présentait un terrain de broncho pneumopathie chronique obstructive (BPCO). Ceci constitue un facteur de gravité des AAA[5].

La complication embolique classiquement décrite après chirurgie de l' AAA a été observée chez un patient, mais une emboléctomie illiaque externe précoce a pu éviter l'ischémie. Nous n'avons pas rencontré de complications rénales, coliques, cérébrales, ni de complication infectieuse des prothèses[14]. Les complications tardives rencontrées (anévrysme anastomotique, occlusion sur brides) ont été décrites dans d'autres séries[14,15] ; ce sont des complications possibles, inhérentes à la chirurgie. Par ailleurs, les suites ont été simples chez la majorité de nos malades avec contrôle satisfaisant au scanner. La durée moyenne d'hospitalisation (17 jours) était comparable aux 16,4 jours de Cappeller et al[16]. L'indication opératoire n'a pas posé de problème pour nous. L'importance de la taille des AAA rencontrés (66,35 mm avec des extrêmes de 50 et 96 mm) ne permettait aucune discussion. Par contre, dans la littérature les options étaient souvent multiples. Ainsi, la plupart des auteurs s'accorde à opérer les AAA supérieurs à 50 mm[5,17] ou lorsque le diamètre augmente de 15 mm par an[3]. Pour les AAA, le taux de rupture sans traitement (25%) est important. La rupture constitue la principale cause de mortalité pour les AAA non opérés. Dans la plupart des cas de rupture, la mort survient avant l'intervention et seulement 20 à 50% des opérés survivent[18,19]. De même, le choix du type de chirurgie ne s'est pas posé à nous. La Chirurgie endovasculaire dans le traitement des AAA sous-rénaux n'est pas encore entrée dans notre pratique.

Actuellement, elle a les mêmes indications que la chirurgie classique[20,21]. Son taux de mortalité est plus faible dans la première année[22,23], mais au-delà, les complications et ré- interventions sont plus fréquentes. De plus, la chirurgie endovasculaire de l'AAA sous rénale n'a pas encore suffisamment de recul[23]. C'est pourquoi, Zarins et al[21] pensent qu'elle ne remplace pas la chirurgie classique mais augmente les options thérapeutiques.

Conclusion

L' AAA sous -rénale, pathologie du sujet âgé,est souvent d'origine athéromateuse, bien que l'origine infectieuse reste encore en bonne place. Son volume important impose une prise en charge chirurgicale rapide. Elle est du ressort de la chirurgie classique au Sénégal. Ailleurs la chirurgie endo-vasculaire constitue une option complémentaire. La seule alternative à l'évolution vers la rupture reste la chirurgie.

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