

COMPARISON OF ETHIBOND VERSUS STANDARD WIRE STERNAL CLOSURE IN ELDERLY PATIENTS

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All the authors contributed significantly to the research that resulted in the submitted manuscript.

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ABSTRACT

Objective: The purpose of this study was to compare Ethibond sternal closure versus standard wire closure in elderly age group as a determinant and risk of mortality and morbidity in cardiac surgery in our institutional patient population.

Methodology: Between January 2006 and December 2008 information on risk factors and mortality was collected for 800 consecutive adult patients undergoing cardiac surgery under cardiopulmonary bypass. 128 patients above 65 years of age were retrospectively divided to those who underwent sternal closure using either Ethibond (n=60) or standard metal wire (n=68). Follow-up data on sternal and wound healing was assessed for up to one year post surgery in the outpatient clinics.

Results: The following factors were associated with a higher morbidity in both the groups: age (2%), female gender (2%), kidney function, peripheral arteriopathy, COAD, severe neurological problems (1% each), prior cardiac surgery, recent MI, left and right ventricular function, chronic heart failure, elevated pulmonary pressure, acute endocarditis, symptomatic angina (2-4% each), procedure timing, seriousness of the preoperative condition, Perforated ventricular septum, other non bypass surgery, chest surgery, each accounting for a 1-4% increase in morbidity.

Mortality was zero in both groups, so was the number of sternal dehiscence and deep sternal infection (total of zero cases) during the first month of follow up post surgery. 12 patients had superficial sternal wound infection, 7 patients from group A (Ethibond) and 5 from group B (standard wire). Pain scores in both groups did not exceed 7 out of a 0 to 10 scale and the pain was relieved by Paracetamole and Codeine.

Conclusion: This study showed Ethibond sternal closure was not associated with increased complications or patient discomfort due to sternal wound than the standard wire closure, in the elderly age group.

Keywords: Sternum, Ethibond, Elderly Patients

INTRODUCTION

In the year 1998 to 2000 about 11% of the patients undergoing heart surgery were older than 65 years of age, but this figure increased to 27% between the years of 2006 and 2008, this is because of the improved medical guidelines as well as the improved socialites, which hinder, surgical procedures, but as a result of continually improved modalities, tools and equipment, cardiac surgery is feasible in high-risk groups [1]. Sternal closure methods has improved over the past years two, methods including standard wire closure and Ethibond closure. Despite improvements in surgical techniques, anesthesia and antibiotic treatment, postoperative wound reopening still represents a significant and lethal complication after cardiac operations.¹⁻³ The origin of this condition has multiple causes and includes factors such as the use of internal mammary artery as a pedicled graft, longer stay in the intensive care unit, reexploration, diabetes mellitus and obesity.⁴

The Euro Score S points out a number of risk factors which help to anticipate mortality and morbidity from heart surgery.^{1,2} The percentage of anticipated mortality and morbidity is found by adding the numbers attached to each factor. Since its founding in 1999, ES has extensively been adapted in Europe and other countries and has been the core of various analyses. High Euro score counts increase the risk of sternal complications, but if the factors were neutralized amongst study groups, In particular, the type of sternal closure technique has been implicated in adversely affecting wound-related morbidity.⁵

METHODOLOGY

Information about 800 patients who had heart surgery between January 2006 and December 2008 was gathered and these patients were retrospectively studied. The data was collected from patient's files, clerking and follow up notes, operative history, or from the patients themselves. A simple form was then developed to record information on 128 patients who were older than 65 years of age. (90 men, 38 women, mean age 70 ± 5 years) who underwent first-time cardiac surgery from Jan 2006 to December 2008 were enrolled in the study. Patients were retrospectively randomized into two groups: Group A, using Ethibond, and Group B, using metal wires. Exclusion criteria included emergency operations and redo cardiac surgery.

According to the ES assumption procedure, our patients were also divided to two categories, the ES and the age-adjusted ES. Results were added for every patient, in the latter case by deducting the scoring values for the related age group. Afterwards, the occurrence of post surgical sternal problems and one month complications were identified and neutralized for both groups. Finally, statistical

analyses were done with the aim to identify Ethibond sternal closure as a risk in sternal complications in heart surgery. The occurrence of DM, high blood pressure and arrhythmias, i.e., the risks which are not determined by the ES, which showed an important age dependence in the patients analyzed and were further noted to be present equally in both study groups. A conventional cardiopulmonary bypass was used when the surgical procedure for a patient required cardiac arrest. The flow rate during bypass was 2.4 liter/m²/minute. Systemic temperature was maintained between 34°C and 36°C. Myocardial protection was achieved by using intermittent antegrade hyperkalemic warm blood cardioplegia. In patients in Group A, the sternum was united using 6 to 8 sutures with #2 braided polyester sutures (Ethibond, Ethicon Inc., Somerville, NJ). Group B patients' sternum was closed using 6 to 8 single interrupted number 5 stainless steel wires. In all patients, the wound over the sternotomy was closed in three layers. The deep layer was closed with 0-0 Vicryl sutures and the middle layer with 2-0 Vicryl sutures. The skin was approximated with subcuticular 3-0 Vicryl sutures. Both groups of the patients received the same antibiotic regimen of second generation Cephalosporines every 8 hours for 72 hours. X-rays of the chest were recorded to assess the healing of the sternum one month after surgery. Cuts in the wires and gaps in the sternum were checked using the x-rays if any doubt was there, CT scans of the sternums were done and the images were analysed. Follow-ups in the outpatient clinic were made over a period of at least one year to check sternal wound healing. Pain was assessed according to medical charts, pain score note and analgesic requirements.

RESULTS

Patient characteristics:

The mean age of the studied patients was 70 years. Age range was 65 to 77 years, 27% of patients were aged 66 years or over and 28% were female. Mean BMI was 22.3 ± 3.9 . And 3% of patients can be classified as grossly obese with a BMI of 33 or over. Systolic arterial blood pressure exceeded 145 in 45% of patients and diastolic pressure exceeded 90 in 10%. DM was present in 33% divided as follows: 9% on insulin, 22% on oral therapy and the rest on diet control.

Gross age-dependent differences variations in divisions of the following variables were identified: females, (COAD), non-peripheral atherosclerosis, neurological problems, incrementing angina, ejection fraction 30-50%, and additional heart procedures (CABG), aortic surgery, high blood pressure, diabetes and arrhythmias. The ES and the age-adjusted ES values were determined. Sixty patients (44 men, 16 women) were assigned to Group A and sixty

Table 1: The Euro Score

Variable	Definition and Scoring	
Patient Related Factor		
Age (Years)	Per 5 Years or Part thereof over 50 Years	1
Gender	Female	1
Chronic Pulmonary Disease (COPD)	Long Term use of Bronchodilators or steroids for Lung Disease	1
Extra Cardiac Arteriopathy	Any One or More of the following: claudication, carotid occlusion or >50% stenosis, previous or planned intervention on the abdominal aorta, limb arteries or carotids	2
Neurological Dysfunction	Disease severely affecting ambulation or day to day functioning	2
Previous Cardiac Surgery	Surgery requiring opening of the pericardium	3
Serum Creatinine	Serum Creatinine >200 µmol/l Preoperatively	3
Critical Preoperative State	Any one or more of the following: Ventricular tachycardia or fibrillation or aborted sudden death. Preoperative Cardiac massage, Preoperative ventilation before anesthetic room, Preoperative Inotropes or Intra-Aortic balloon pump, Preoperative acute renal failure (anuria or oliguria < 10ml/h)	3
Cardiac-related factors		
Unstable Angina	Rest Angina requiring intravenous nitrates until arrival in anesthetic Room	2
Left Ventricular Dysfunction	Moderate or Left Ventricular ejection fraction 30-50% poor or left ventricular ejection fraction <30%	13
Recent myocardial infarction	Myocardial Infarction within 90 days	2
Pulmonary Hypertension	Systolic Pulmonary Artery Pressure >60 mmHg	2
Operation_Related Factors	Emergency Carried out on referral before the beginning of the next working day	
Other than Isolated CABG	Major Cardiac procedure other than or in addition to CABG	2
Surgery on thoracic Aorta	For disorders of ascending, arch or descending aorta	2
Score 0--2 3--5 6--	Risk Low Medium High	Expected Mortality (95% confidence limits) 1,27-1,29% 2,90-2,94% 10,93-11,54%

Table 2: Postoperative data

Characteristic	Group A (n=60)	Group B (n=68)	p Value
Sternal Dehiscence	0	0	NS
Mediastinitis	3	0	NS
Change of Antibiotics	5	6	NS
Deaths	0	0	NS
Major Morbidities	0	0	NS
Cardiac Complications	0	0	NS
Cerebral Complications	0	0	NS
ICU stay (days)	2.1	2.1	NS
Sternal wound complications during 1 Year after surgery ICU=intensive Care Unit, NS= Not Significant	0	0	NS

eight patients (46men, 22 women) to Group B. The preoperative demographic and surgical data are shown in Table 1. The groups were similar with respect to age, gender, New York Heart Association functional class, number of patients with left ventricular ejection fraction of less than 40% and preoperative risk factors such as diabetes mellitus. The following factors were associated with a higher morbidity in both the groups: age (2%), female gender (2%), kidney function, peripheral arteriopathy, COAD, severe neurological problems (1% each), prior cardiac surgery, recent MI, left and right ventricular function, chronic heart failure, elevated pulmonary pressure, acute endocarditis, symptomatic angina (2-4% each), procedure timing, seriousness of the preoperative condition, Perforated ventricular septum, other nonbypass surgery, chest surgery, each accounting for a 1 -4 % increase in morbidity

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scale and the pain was relieved by Paracetamole and Codeine.

The patients were also divided into different age categories, all of them had undergone heart surgical procedures. Elective surgery accounted for 75% of surgeries, with 25% being urgent but no emergent surgeries were counted. Isolated CABG was done in 65% of patients and 31.4% had valve surgeries. Two thirds of CABG patients had three or more grafts, 24% had two and only 10% had one. Aortic valve surgery accounted for 58% of valve surgeries, mitral repair or replacement 30% and AVR 13%, and the patients were equally divided amongst both groups

Each surgery showed a percentage of post operative problems, which were non sternal related. The percentage of CABG was less in the elderly patients while the percentage of valve, especially aortic valve replacements increased with older age. The monthly morbidity and the occurrence of most postoperative complications rose significantly with increasing age.

DISCUSSION

The changing risk profile in cardiac surgical patients over the

Table 3: Preoperative demographic data

Characteristic	Group A (n=60)	Group B (n=68)	p Value
Age (Years)	70±5	70±5	NS
Male / Female	44/16	046/22	NS
NYHA Class III or IV	36(17%)	20(20%)	NS
EF <40%	18 (30%)	16(24%)	NS
Risk Factors			
Diabetes Mellitus	20(33%)	22(33%)	NS
Hypertension	26(43%)	32(47%)	NS
Hyperlipidemia	18(30%)	24(35%)	NS
COP	12(10%)	2(3%)	NS

BMI = Body Mass Index; NYHA = New York Heart Association; EF = Ejection Fraction
COPD = Chronic Obstructive Pulmonary Disease,; NS = Not Significant

past decade means that crude procedural morbidity figures are no longer sufficient either for informed consent by patients or for the assessment of the quality of care in institutions.⁶⁻⁸ It is sometimes argued that crude morbidity may suffice for quality of care measurement as it also reflects the wisdom of careful patient selection. This is fallacious in cardiac surgery because of the risk paradox: it has been shown that it is particularly in high risk patients that the superiority of surgical over medical treatment is most pronounced.^{9, 13, 15} It is also argued by some that operative morbidity is not the only important outcome measure, that patients who survive cardiac operations may still have high complications and a poor long-term outcome.^{16,17} Although this argument is undoubtedly true, its impact is much weakened by the fact that both postoperative morbidity and poor late results largely stem from failure to achieve a satisfactory cardiac outcome, all this is further narrowed and reflected on sternal complications as Sternal dehiscence with or without infection was related to factors such as obesity, diabetes mellitus, chronic pulmonary disease, reexploration, length of stay in the intensivecare unit, and type of sternal closure.^{4,8,9} The incidence of this

complication is rare; however, it is accompanied by a high mortality ranging from 16 to 26%.^{2,10} This multi-factorial wound-related morbidity required retrospective randomized assessment of the technique of sternal closure. In other words, low early morbidity is likely to be associated with low sternal complications and good long term results. Therefore, relating sternal wound complications to generalized operative risk remains the mainstay of any system that assesses the quality of cardiac surgical care.^{10,11} which in turn is reflected on sternal well being.

The goal of wound care and closure is to have a resultant functional and cosmetically acceptable scar, with low morbidity combined with high patient satisfaction and comfort. These goals can be promoted by complete sternal closure. Few studies have evaluated, in a prospective and randomized fashion, the condition of wounds during the mid-postoperative period.

Our study is a trial to determine whether the Ethibond sternal closure technique produces clinical sternal healing similar to results seen with wire closure. No statistical difference was seen in the incidence of sternal wound complications, including sternal dehiscence and mediastinitis, in the early

postoperative period and subsequent year of follow up.

The improvement in medical interventions as well as the enhanced demographical factors, which in turn delayed, if any, surgical interventions, but as a result of continually improving surgical strategy and the technology which supports it, cardiac surgery is now possible in an increasingly high-risk population. Many risk factors have been associated with cardiac surgical mortality. Some are preoperative patient characteristics, others are related to the type and severity of the cardiac disease itself and a third group are related to the type and extent of the surgical procedure. Although the risk factors selected for evaluation in this study were largely similar to those in other studies, it should be noted that, whenever possible, objective and simple definitions were provided.

The aging process is associated with structural and functional changes in various organ systems, which may influence the preoperative outcome. The age-dependent changes in other than cardiovascular body organ systems require specific preventive and therapeutic measures. For instance, the well-known age-related changes in lung structure and function (e.g., increase in functional residual capacity and residual volume, weakness of the expiratory muscles, malfunction of the airway epithelium accompanied with increased production of mucus, diminished tendency to cough, increased ventilation-perfusion mismatch) may lead to complications in older patients undergoing cardiac surgery.²² Cardiovascular age-dependent changes which have previously been identified such as: dilation of large vessels, thickening of vessel walls, affecting first of all the intimal layer, loss of vessel elasticity²¹, increase in left ventricular afterload^x thickening of left ventricular wall²², cardiac myocyte cell loss and increase in the amount of myocardial collagen¹⁹, decline in early diastolic left ventricular filling rate²⁰, increased atrial contribution to ventricular filling and larger atrial diameter¹⁸, reduced adaptability of the cardiac response to different workloads resulting from modified ventricular filling volumes and changes in heart rate¹⁷, increasing deficits in sympathetic modulation²¹, changes in myocardial calcium hemostasis, affecting the excitation-contraction coupling and, consequently, the myocardial contractility and tendency to arrhythmias.²⁶ The consequence of all the above-mentioned changes is the reduced cardiac adaptability to workload observed in the elderly.^{24,25} Again this aspect may be hidden in the Euro SCORE parameter 'age'.

Many cardiac surgeons have learnt from experience that the above mentioned age hidden factors are important determinants of outcome, and this is supported by recent work and study results as well as clinical findings.

CONCLUSION

In conclusion Ethibond showed no differences in comparison with standard wires, not only in the incidence of sternal wound complications but also in the intensity of postoperative chest pain. Ethibond provides the added benefit of enabling nuclear magnetic resonance imaging.

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