Conversion from Ministernotomy to Full Sternotomy in Aortic Valve Replacement

(#2001-6925 … June 27, 2001)

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Presented at the Fourth Annual Scientific Meeting of the International Society for Minimally Invasive Cardiac Surgery, June 27-30, 2001, Munich, Germany.

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ABSTRACT

Conversion (C) from ministernotomy (M.S.) to full sternotomy was necessary in 5% of the cases in a series of 100 patients consecutively operated for Aortic Valve Replacement (A.V.R.)

Analysis of the demographics and surgical techniques indicate older age, aortic fragility, diffuse coronary disease, chronic renal failure and left vent insertion as contributing factors.

Despite increased operative blood losses, extra-corporeal circulation (E.C.C.) times, intensive care unit (I.C.U.) stay and hospital stay, no mortality was observed in the conversion group, as compared to 4.2 % mortality in the total ministernotomy (MS) population.

Preoperative patients selection, avoidance of technical pitfalls, and knowledge of alternative surgical measures are suggested to further decrease the incidence of conversions.

INTRODUCTION

Aortic valve replacement through a mini-invasive approach has been described since 1996 [Cosgrove 1996]. Although parasternal incisions were initially carried out, an upper median sternotomy skewed to the 3rd or 4th right intercostal space is currently recommended by most authors. The rationale and techniques of less invasive aortic surgery have been recently reviewed [Von Segesser 1999].

While the actual benefit in terms of reduced post-operative pain, length of stay or hospital cost is still a subject of controversy, it is generally accepted that this procedure can be performed safely, without difference in cross-clamp or E.C.C. times when compared to standard sternotomy. However, caution should be exercised in certain subgroups such as patients with reduced right ventricular function where the lack of protection afforded by topical cooling is a matter of concern [Szwerc 1999].

Obviously, the population of younger patients facing the prospective of reoperation, cases of redo patients with patent coronary bypasses, or more generally those concerned by the psychologic, cosmetic and self-esteem aspects of a reduced incision are most likely to benefit from this technique.

It is still a subject of debate whether older patients with reduced pulmonary function, in whom postoperative pain, cough restriction, lung infections and sternal instability are frequent, could be helped by partial sternotomy. Postoperative ventilatory dysfunction was not influenced by the use of MS versus sternotomy in a randomized study [Aris

1999]. Preoperative evaluation by scoring systems could help and identify groups of patients with increased risk of morbidity and clarify this issue.

In a context where the real benefit of a reduced incision is still under scrutiny, it seems of utmost importance to avoid additional risks induced by a limited access, and to assess the complications specifically related to the new technique. Conversion from ministernotomy to full sternotomy could represent such a factor of additional morbidity.

The incidence of this complication is variable in the literature: Cuenca [Cuenca 1998] and Svensson [Svensson 2001] report no conversions in series of 25 and 54 patients respectively. Aris [Aris 1999] reports 2 out of 20 cases (10%).
Those figures are evidently influenced by the small sample size and should be taken cautiously.

The causes of conversion are multiple: Minale [Minale 1998] had to convert 1 patient out of 50 (2%) for haemorrhage from a fragile aorta. Tam [Tam 1998] had 1 out of 19 patients (5.2%) who needed open defibrillation after MS. Mächler [Mächler 1999] describes 2 peroperative C (1 for coronary bypass and 1 for exposure) and 1 postoperative C at reexploration for bleeding, in a series of 60 patients (5%). Frazier [Frazier 1998] reports 1/17 (5.8%) conversion for exposure problems.

MATERIAL AND METHODS

In a series of 100 patients consecutively operated for Aortic Valve Replacement (A.V.R.) through Ministernotomy, 5 (5%) needed peroperative conversion to full sternotomy. The operative technique of MS has been extensively described [Von Segesser 1999]. Briefly, a 6 cm incision starting 2 cm below the sternal notch was used. The superior part of the sternum was divided in a J fashion down to the 3rd or 4th right costal interspace. The aorta was cannulated by a DLP 24 FR straight tip cannula (Medtronic, Minneapolis, MN) and the right atrium by a RMI dual-stage drainage venous cannula (Baxter Healthcare Corporation, Irvine, CA). Cardiopulmonary bypass was conducted at 2.4 L/m2, and moderate hypothermia at 34°. A vent catheter (RMI 20 FR) was inserted through the right superior pulmonary vein into the left ventricle. Aortic root cardioplegia (St Thomas solution) and supplementary injections into the coronary ostia were used. Retrograde cardioplegia, femoral cannulation or active venous drainage were not used. Transoesophageal echography (T.E.E.) was used routinely to monitor deairing and weaning off bypass. The usual contraindications to MS [Von Segesser 1999] were followed.

The demographics of the 95 MS patients are illustrated in Table 1: male/female ratio was 45/50 and mean age was 69.4 years. The valve pathology was stenosis in 67%, insufficiency in 16% and mixed in 17%.
Mechanical valves were implanted in 40 cases and biological valves in 55 cases.
Two patients underwent patch enlargement of the aortic annulus, and a mechanical valve needed repositioning in 1 case. Excessive postoperative drainage occurred in 2 patients and these were reoperated through the MS.

Conversions

The five patients needing conversion are detailed in Table 1: There were 3 males and 2 females, and the mean age was 75 years vs 69.4 years in the MS group ($p = 0.005$).

Aortic cross-clamping time was similar between MS and C patients, (79 +/- 16 vs 76 +/- 30 min., NS), but total C.P.B. time was significantly higher in the conversion group (140 +/- 40 vs 108+/- 25 min.) ($p<0.01$).

Operative blood losses were markedly higher in the C group: 1300 +/- 600 ml vs 292 +/- 344 ml, ($p<0.001$), as the majority of conversions (3/5) were due to haemorrhage.
Intensive care unit stay was 1,8 days in the MS group and 2,8 days in the C group (NS).
Total length of stay was 14,7 days in the MS group and 17,8 days in the C group (NS).

Table 2 summarizes the indications, the operative data and the outcome of the five patients.

DISCUSSION

In this short series of 5 patients needing C from MS to sternotomy, the majority of C was caused by bleeding (3 out of 5). In the first case, a transverse incision was used, and proved difficult to repair through the MS. As pointed out by others [Von Segesser 1999] the proximal aorta tends to fall back into the pericardium after aortic unclamping, making control of the suture line challenging. Growing experience with the MS procedure led us to favour oblique incisions, avoid dilated or fragile aortic wall for MS, and exercise caution in extending the incision into the non-coronary sinus (although incidental patch enlargements of the aortic annulus were performed uneventfully in 2 patients).

The 2 other haemorrhagic cases were due to left vent insertion complications. In fragile female patients with friable tissues such as case nr 2, or in patients with chronic lung diseases, such as case nr 5, left vent insertion into the right superior pulmonary vein can be challenging. In MS, the inability to manipulate the heart to guide the catheter through the mitral valve often leads to multiple attempts to insert the vent blindly into the left ventricle, with the inherent risk of left atrial trauma. Suggestions to prevent this complication include: transoesophageal echocardiography guidance of the catheter insertion, use of atraumatic material and use of a knot pusher (in cases of deep thorax[for the vent purse string suturing and tying, and selection of alternative insertion sites, such as the dome of the left atrium or the common pulmonary trunk should difficulties been encountered. While the amount of blood losses was low in the MS group, the C group showed a marked increase in peroperative losses. Thus, it seems advisable to maintain a cell-saver system in stand-by should C be needed. =

A cell saver was used in case nr 5 and allowed the treatment of an amount of 4000 ml of blood. Apart from the anecdotal foreign body retrieval case, the remaining C case was due to unexpected coronary insufficiency and anterior malperfusion, although only diffuse atheromatosis was seen on the coronary angiogram. This case underscores the usefulness of T.E.E. in localizing the ischemic zone, and the necessity of a careful preoperative revision of the coronary angiogram to detect significant stenosis, and to be able localize the target vessel should unexpected coronary bypass be needed.

When compared to the MS group, the C group was significantly older, and several patients showed preoperative morbidity such as chronic renal failure and respiratory insufficiency. Patients selection for MS, whether as a younger age group if the cosmetic aspect is predominant, or as an older and high-risk group if small incisions are considered beneficial to recovery, is still a subject of discussion. Of note, the postoperative course in the C patients did not seem to be influenced by the conversion, as no specific sternal complications occurred. The length of stay in our series of MS (14.7 days) is long compared to American standards. Several considerations can explain this difference: the preoperative stay is included, the mean age (69.4) is about 10 years higher than in most published American series, and the global Euroscore of the MS population is 6 (high risk category). Svensson [Svensson 2001] mentions a length of stay (L.O.S.) of 6,7 days for a mean age of 60.8 years, and Szwerc [Szwerc 1999] 5.7 days for a mean age of 60 years. In contrast, European series report 10 days of stay for a mean age of 68 years [Minale 1998], or 7 to 10 days for a mean age of 65 years [Mächler 1999]. Older, isolated and debilitated patients are often reluctant to leave the hospital until they are fully rehabilitated. More generally, comparison of L.O.S. between different systems of health care delivery is difficult if parameters such as the existence of out of hospital intermediate care units or financial pressure from third party payers is not taken into account.

The prolonged postoperative stay as compared with the MS group is confounded by the multiple morbidities encountered in the C group. Finally, no mortality was observed despite these factors in the C group.

CONCLUSION

The 5% frequency of conversions in our series concurs with the literature data. No mortality was observed in this older and more complicated group of patients, although ICU and total hospital stay were higher. Careful preoperative selection, peroperative management and choice of alternative technical solutions should help and lessen the incidence of C, and reduce their consequences when they occur. Ministernotomy for A.V.R. remains a valuable approach in most patients categories, although the real benefit apart from the cosmetic aspect is still debated in the literature.

Acknowledgments

The authors thank Dr. Serge Brimioulle for his help in statistical analysis, and Mrs. Chantal Beriou and Antonia Alvaro for their secretarial contribution.

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Table 1

	GROUP C	GROUP MS	P value
N	5	95	
M/F	3/2	45/50	
Age	75 +/- 9.4	69 +/- 12.2	N.S.
ECC duration (min)	140 +/- 39.9	108 +/- 25	P < 0.01
Ao cross-clamp (min)	76.8 +/- 29.6	79 +/- 16	N.S.
ICU stay (days)	2.8 +/- 1.8	1.8 +/- 2.4	N.S.
Hosp. Stay (days)	17.8 +/- 5.3	14.7 +/- 7.5	N.S.
Operative losses (ml)	1300 +/- 600	292 +/- 344	P < 0.001
Mortality	0 (0%)	4 (4.2 %)	N.S.

Table 2

N¡	Age	Sex	Ao disease	Comorbidities	Ao incision	Prothesis	Cause of conversion	ECC	Outcome
1	83	M	S, bicuspid valve	Dilated Ascending aorta, Left heart failure	T	23CE	H, Suture line	C on bypass	D/C P.O.D.11.
2	63	F	I, Chronic endocarditis	Chronic renal failure, pulmonary embolism	O	23HP St J	H, L atrial appendage (vent line?)	Repeat ECC under ECM	D/C P.O.D 18
3	72	M	S, calcified	Chronic renal failure	O	25CE	Foreign body retrieval	C on bypass	Transient neurologic deficit, lung an urinary infections, D/C P.O.D. 20
4	86	F	S	A fib,diffuse coronary disease	O	25 St J Toronto	L.A.D. occlusion, LIMA-LAD bypass	C on bypass	A Fib D/C P.O.D.18
5	71	M	S	C.O.P.D., tuberculosis	O	21 CE	H, L atrium (vent line)	Repeat ECC	Respiratory insufficiency, A Fib, D/C P.O.D.15

Abbreviations: CE : Carpentier-Edwards, C.O.P.D. : chronic pulmonary obstructive disease, D/C : discharged, ECM : external cardiac massage, H : haemorrhage, I : insufficiency, L.A.D. : left anterior descending artery, LIMA : left internal mammary artery, T : transverse, O : oblique, P.O.D.: postoperative day, S : stenosis, StJ : StJude, C: conversion, ECC :extra-corporeal circulation, A Fib. : atrial fibrillation