The Egyptian Journal of Hospital Medicine (January 2023) Vol. 90 (2), Page 3422-3427

The Mini-Bentall Approach in Aortic Root Aneurysm Surgery

Mohamed Husseiny Mahmoud
Department of Cardiothoracic Surgery, Faculty of Medicine, Al-Azhar University, Cairo, Egypt
Corresponding author: Mohamed Husseiny Mahmoud, **Tel.:** 01027759750**, Email:** mohamedelhossinycts2016@gmail.com

ABSTRACT

Introduction: Full sternotomy is the gold standard for aortic root surgery. However, some individuals may benefit from an upper mini-sternotomy. **Objective:** The aim of the present study was to match results between cases who received aortic root replacement by an upper mini-sternotomy (mini-Bentall) and those who underwent the treatment through a median sternotomy (full-sternotomy Bentall).

Patients and methods: A total of 20 patients got the full-sternotomy Bentall operation and 9 patients underwent the mini-Bentall treatment between November 2016 and November 2020. Mini-Bentall surgery was accomplished by an incision beginning at the right upper sternal border and finishing at the fourth right intercostal gap. Concurrent surgeries, such as mitral valve intervention or aortic dissection, and profound hypothermic circulatory arrest, disqualified patients from participation. Major surgical complications and operative mortality were measured, as were open chest and re-exploration for bleeding, hospital length of stay, blood transfusion rates, and duration of mechanical ventilation**.**

Results: The rate of serious postoperative problems, including the need for a blood transfusion, was not significantly different between the two groups. There were no cases of stroke in either group, and the mini-Bentall group did not have any conversions to median sternotomies.

Conclusion: In certain individuals undergoing elective aortic root replacement surgery, a partial upper J-shaped sternotomy can be a secure and alternative approach. Unfortunately, further research is needed before this method can replace current best practises.

Keywords: Mini-Bentall, Full-sternotomy Bentall, Aortic Root Aneurysm, Case series, Al-Azhar University.

INTRODUCTION

Aortic root replacement surgery, done by a thorough median sternotomy, often involves the replacement of a composite valve graft. To replace the aortic root and ascending aorta in cases of aneurysm, the upper mini-sternotomy method has been performed on occasion [(1)].

This method has achieved widespread popularity among surgeons as a result of its success in reducing surgical trauma and discomfort, reducing blood needs, lowering complication rates, and increasing patient satisfaction. Thus, there is a lack of information on the effectiveness and safety of the mini-sternotomy method to aortic root and ascending aorta replacement.

This research set intended to compare complete sternotomy Bentall procedures to those performed through an upper sternotomy (mini-Bentall) in terms of safety and patient outcomes following aortic root replacement [(2)].

PATIENTS AND METHODS

Data were obtained from Nasser Institute Hospital for Research and Treatment and Al-Hussein University Hospital, for all adult patients who had elective Bentall surgeries between November 2016 and November 2020.

A total of 20 patients had full-scale sternotomies for the Bentall treatment, while 9 others had less invasive mini-Bentalls. Patients who required aortic arch replacement or who previously had surgery for a type A dissection were not included in this research.

Surgical Technique of the Mini-Bentall and full-Bentall Preparation: As with other endotracheal anaesthetic procedures, the Bentall operation was completed with the patient lying face up. Arterial lines were placed in the radial and femoral arteries, and a temperature-monitoring Foley catheter was utilised to keep tabs on the heart. The skin was prepped and draped as per usual.

Exposure: An incision was performed in the midline of the patient's chest for a full Bentall sternotomy, which reached from two centimetres below the sternal notch to the xiphoid process. The "J-type" sternotomy exited the right fourth intercostal space (ICS) and a 1-cm midline skin incision was performed above the manebro-sternal angle to the fourth ICS. When the sternotomy was finished, the innominate vein was reached and the anterior thymic tissue was excised. Regular incisions were made in the pericardium, and shapes were fashioned. Tractioning the pericardium cephalad in the Mini-Bentall technique helps bring the aortic root into view. The aorta must be accessed for tapping by meticulously dissecting the aorto-pulmonary space.

Cannulation:

The aorta was cannulated on the anterior surface of the distal ascending aorta immediately below the innominate artery, and the rt atrium was cannulated on the rt atrial appendage face using a central cannulation method. After a sufficient amount of active clotting time was attained, cardiopulmonary bypass (CPB) was started. Consistently, a systemic temperature of 28 degrees Celsius (moderate hypothermia) was employed. A vent was inserted into the aortic root. After antegrade cardioplegia was given and the aortic cross-clamp was applied, a direct pulmonary arterial vent was inserted and secured. A cephalad traction suture was placed around the aortic cross-clamp to allow for further exposure.

Received: 20/10/2022
Accepted: 23/12/2022

Procedure: As a standard practise, 2-liters (L) of Custodiol histidine-tryptophan-ketoglutarate (HTK) cardioplegia solution was infused antegrade into the coronary ostia in patients with severe aortic regurgitation to ensure myocardial protection. Following successful induction of cardiac arrest, the aorta was transected 1 centimetre caudal to the sinotubular junction and the aortic cross-clamp was released. The cephalad orientation of the ascending aorta was restored by a retraction suture. The root of the aorta was then evaluated. In order to close the commissures, pledgeted 4-0 Prolene sutures were put at the end of each one and then tightened; checking out the aortic valve. After completing a pulmonary artery dissection, the noncoronary sinus was excised and the right and left major coronary buttons were fashioned to protect the artery.

There was a removal of the aortic valve leaflets. Only three patients require Hancock tissue valves; the others have mechanical SJ valves. First, a 4-0 prolene continuous suture is used to sew the suitable Dacron Hemashield synesthetic tube graft to the selected valve. The aortic ring was repaired using a basic interrupted technique and a series of 2-0 Ethibond pledgeted annular sutures for strengthening with the other aortic sinuses. Keep the aortic valve transplant in place. The graft was then sutured with eithibond sutures. An anastomosis was performed between the transplant and the left coronary button first, and then the right. After that, we used interrupted 4-0 prolene sutures with Teflon to strengthen the inferior aspect of the distal anastomosis.

The aortic clamp was unfastened and temporary epicardial pacing wires were implanted in the right ventricle. Protamine was used along with proper clotting. Mini-bentall sternal closure utilised three stainless steel wires. The ICS (4th) is located just laterally to the sternum, and it is used to extrude epicardial cables and mediastinal drains. Similar procedures were used for complete sternotomy Bentall surgery.

Variables: Each participant's demographics, preoperative clinical features, intraoperative course, and postoperative results were recorded. The tabular displays in the results section provide a catalogue of such factors.

Ethical Approval:

This study was ethically approved by the Institutional Review Board of the Faculty of Medicine, Al-Azhar University. Written informed consent was obtained from all participants. This study was executed according to the code of ethics of the World Medical Association (Declaration of Helsinki) for studies on humans.

Statistical Analysis

All statistical analysis was performed using IBM SPSS Statistics for Mac, Version 23 (IBM Corp, Armonk, NY USA). Qualitative data were defined as numbers and percentages. Chi-square test and Fisher's exact test were used for comparison between categorical variables as appropriate. Quantitative data were tested for normality by Kolmogorov-Smirnov and Shapiro-Wilk tests. Normal distribution of variables was described as mean and standard deviation (SD), and non-parametric data was described as median and interquartile range (IQR). Independent sample t-test and Mann-Whitney test were used for comparison between groups. Survival analysis was calculated using Kaplan Meire estimator. P value ≤0.05 was considered to be statistically significant.

RESULTS

Age was significantly increased in full sternotomy group. There was no significant difference between the both groups regarding sex distribution (**Table 1**).

Table (1): Demographic data of included subjects in both groups.

Variable	Full Sternotomy (N= 25)	Minibental Sternotomy (N= 15)	P-value
Age (years)	56.68 ± 8.73	45.33 ± 14.88	0.00415*
Sex N (%)			
Female	6 (24%)	0	0.067
Male	19 (76%)	15 (100%)	

Hypertension and Diabetes Mellitus prevalence were significantly increased in full sternotomy group (**Table 2**).

Table (2): Co-morbidities of included subjects in both groups.

Variable	Full Sternotomy (N= 25)	Mini-bental Sternotomy (N= 15)	P-value
Hypertension	22 (88%)	5 (33.33%)	0.00015*
DM	12 (48%)	2 (13.33%)	0.02598*
CNS lesion	0	0	-
Renal Impairment	1 (4%)	0	0.95
Liver Impairment	0	0	-

There was no significant difference between the two groups regarding Cardiac evaluation except for Bicuspid AR as it was significantly increased in mini-bental sternotomy group and Aortic diameter as it was significantly decreased in mini-bental sternotomy group. Also severe AR was significantly increased in full sternotomy group (**Table 3**).

Table (3): Cardiac evaluation of included subjects in both groups.

Variable	Full Sternotomy (N= 25)	Mini-bental Sternotomy (N= 15)	P-value
EF (%)	48 ± 0.06	49 ± 0.06	0.55729
Echo			
Aortic root	1 (4%)	0	0.95
Bicuspid AR	0	3 (20%)	0.046*
Moderate AR	0	1 (6.67%)	0.95
Severe AR	24 (96%)	11 (73.33%)	0.036*
Aortic diameter (cm)	6.51 ± 0.6	5.41 ± 0.33	<0.0001

X clamp time and was significantly increased in mini-bental sternotomy group. However, Total operation time was significantly increased in full sternotomy group (**Table 4**).

Table (4): Operative data of included subjects in both groups

Variable	Full Sternotomy (N= 25)	Mini-bental Sternotomy (N= 15)	P-value
Total bypass time (Minute)	289.08 ± 380.8	208.47 ± 13.32	0.41997
X clamp time (minutes)	148.48 ± 13.49	160.2 ± 12.96	0.01035*
Total operation time (minutes)	316.48 ± 22.78	298.67 ± 24.46	0.02523*
Tube graft size (mm)	29.28 ± 1.14	28.67 ± 0.98	0.09034
Valve size (SJ)	24.2 ± 1	23.67 ± 0.98	0.1077

Cold antegrade, ventilation time and re-exploration were significantly increased in full sternotomy group (**Table 5**).

Table (5): Post-operative hospital stays and follows up of included subjects in both groups.

Variable	Full Sternotomy (N= 25)	Mini-bental Sternotomy (N= 15)	P-value
Hospital stay (Days)	8.52 ± 2.1	7.27 ± 2.28	0.08521
Cardioplegia			
Cold Antegrade	3 (12%)	0	0.046*
Custodial	22 (88%)	15 (100%)	0.2788
Support	1 (4%)	2 (13.33%)	0.278
Ventilation time (Hours)	19.24 ± 11.05	7.67 ± 1.35	0.00027*
Strock	0	0	-
AF	1 (4%)	0	0.95
Re-exploration	8 (32%)	0	0.0162*
Renal impairment	0	0	-
Post-operative pericardial effusion	2 (8%)	1 (6.67%)	0.278
Wound infection	4 (16%)	0	0.2778
Mortality	1 (4%)	1 (6.67%)	-

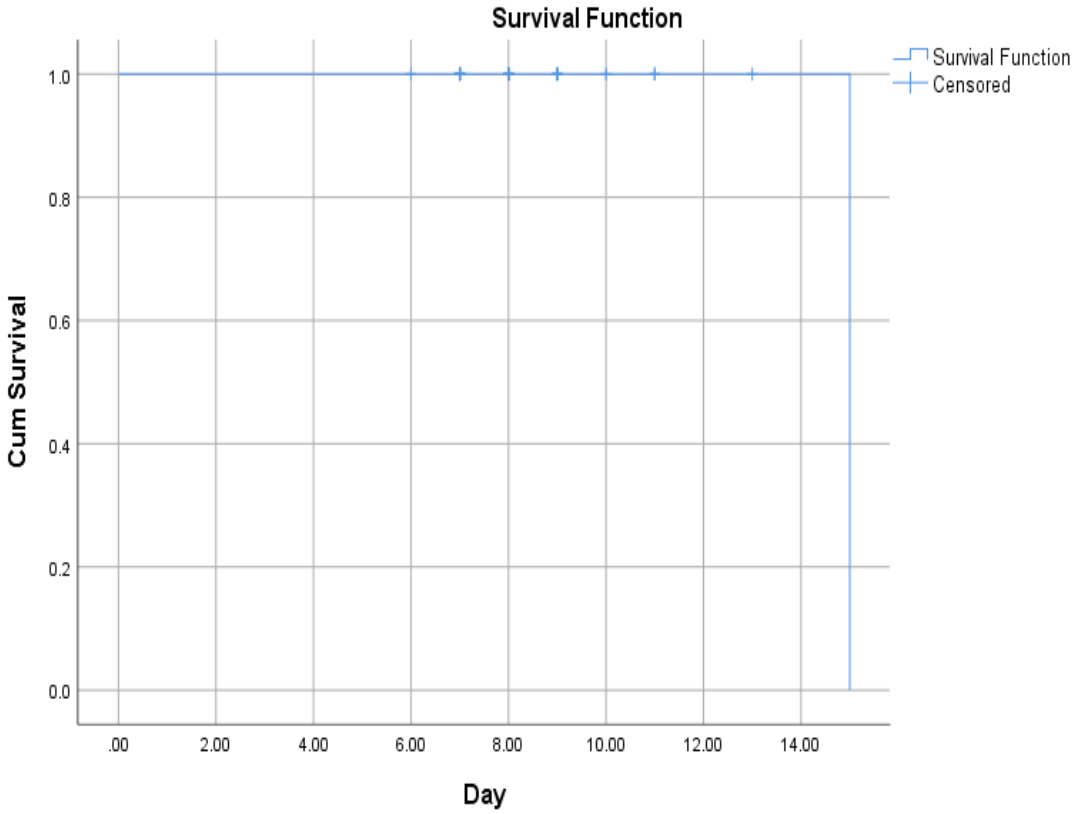

Figure (1): Kaplan Meire survival function in Full Sternotomy group.

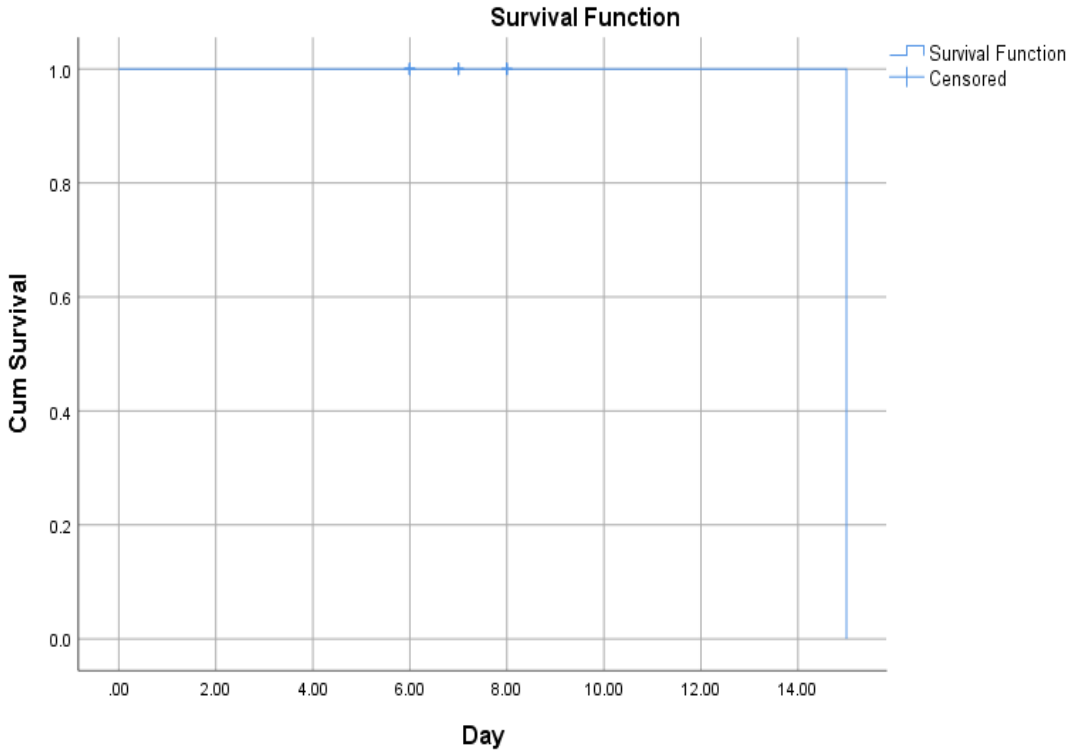

Figure (2): Kaplan Meire survival function in Mini-bental Sternotomy group.

Mortality event occurred for only one case in full sternotomy group after 15 days from surgery. Also, one mortality event occurred in Minibental Sternotomy group after 15 days from surgery.

DISCUSSION

Aneurysms and dissections of the aortic root are both extremely uncommon vascular illnesses that carry a significant risk of death or serious injury to the patient. In terms of surgical procedures, the complete median sternotomy (FMS) is the gold standard. Treatment of aortic valve and aortic disorders with surgery has evolved significantly since the 1990s, with the introduction of minimally invasive surgery (MIS) using a partial upper sternotomy as an alternate entry technique [3].

The purpose of this research was to compare outcomes between patients who received aortic root replacement by an upper mini-sternotomy (mini-Bentall) and those who underwent the treatment through a median sternotomy (full-sternotomy Bentall).

The study was place at Al-Hussin University Hospital, which is part of the Nasser Institute Hospital for Research and Treatment. Twenty patients with full sternotomies and nine individuals with mini-sternotomies were included in the research.

There was a statistically significant difference in age groups in this investigation. The average age of those who underwent a full sternotomy was 56.68 (SD 8.73) years, while those who underwent a little sternotomy were only 45.33 (SD 14.88) years. When comparing the gender breakdown of each group, we found no discernible differences.

Our study are In keeping with those of **Charchyan *et al.*** [4], who used propensity score matching to match the consequences of patients who underwent a full sternotomy vs those who underwent a minimally invasive, valve-sparing operation on the aortic root (PSM). Mini-sternotomy procedures accounted for 160 (36.6%) of the total interventions in the study's sample of 160 participants. In all, 106 patients who had valve-sparing surgery were analysed (David procedure). PSMC was used to divide 60 patients into two groups: group 1 received a full sternotomy (CS), while group 2 received a J-shaped mini-sternotomy (MS). A statistically significant difference between the sexes could not be found.

Our findings corroborated those of **Mikus *et al.*** [5], who wrote about their use of the Bentall method for aortic valve and ascending aorta replacement by a minimally invasive procedure. The total number of participants was 53. A statistically significant difference between the sexes could not be found.

Our findings corroborated those of **Abjigitova *et al.*** [2], who sought to examine whether or not patients fared better after undergoing aortic root replacement by an upper mini-sternotomy (mini-Bentall) or a median sternotomy (fullsternotomy Bentall). Ninety-one patients were a part of the research. A statistically significant difference between the sexes could not be found.

Elghannam *et al.* [3] sought to assess the viability of PUS for root replacement (Bentall) or valve-sparing root replacement (David) at midterm. There were a total of 47 participants. With regards to age, there was no discernible difference among the groups, despite the fact that sexuality was a factor with statistical significance.

The correlation between hypertension and diabetes was statistically significant in the current investigation. The complete sternotomy group had a statistically significant rise in the incidence of hypertension and diabetes. Statistically, there was no difference in the severity of renal impairment across the groups.

Our findings corroborated those of **Mikus *et al.*** [5], who found no statistically significant differences in the degree of renal impairment across the groups studied.

Charchyan *et al.* [4], in contrast to our findings, claimed that there was no statistical significance between groups with respect to DM.

Our results are consistent with those of **Abjigitova *et al.*** [2], who observed no significant difference in renal impairment across the groups. Except for bicuspid AR, which was substantially higher in the mini-bental sternotomy group, and aortic width, which was significantly minor in the mini-bental sternotomy group, our study found no significant differences amongst the two groups for EF or cardiac assessment. There was also a statistically significant increase in the frequency of severe AR in the full sternotomy group.

Our findings corroborated those of **Mikus *et al.*** [5], who found no statistically significant differences in EF across groups.

Charchyan *et al.* [4] observed no statistical significance between groups with respect to aortic root and EF, which contradicts our findings. Total bypass time, valve size, and tube graft size did not differ significantly across groups in our study (mm). The Minimally Invasive Sternotomy group, on the other hand, had longer X clamp times and more complications. Unfortunately, the Full Sternotomy group had a markedly longer total operation time.

By comparison to our findings, **Charchyan *et al.*** [4] found a statistically significant difference in total bypass duration between the two groups they studied (Minute).

Similar to what was shown by **Mikus *et al.*** [5], our findings showed no statistically significant differences in total bypass duration amid the groups (Minute).

No statistically significant differences were seen between the groups in terms of length of hospital stay (days), need for custodial care (care provided by others), postoperative pericardial effusion, or wound infection. Full sternotomy required much more time for breathing and re-exploration during cold antegrade. Our results supported with **Charchyan *et al.*** [4] who reported that there was no a statistical significance between groups regarding to AF.

Our findings corroborated those of **Mikus *et al.*** [5], who found no statistically significant differences in hospitalisation duration between the study groups (days). After 15 days, just one patient in the complete

sternotomy group had died. After 15 days, there was a single death in the Mini-Bent Sternotomy group.

In accordance with the findings of **Elghannam *et al*. [3],** we found that one post-operative death occurred only in the bental group (12 months).

Similarly, **Mikus *et al*. [5]** found that only five patients in the complete sternotomy group (N= 112) died 30 days following surgery, which is consistent with our findings.

The mortality and morbidity rates of the minimally invasive and complete sternotomy groups were similar in the study by **Tabata *et al*. [6]**.

In addition, **Totaro *et al*. [7]** presented the biggest series (67 Bentall) of difficult cardiac surgeries utilising a minimally invasive approach demonstrating good results in a very varied patient group employing various surgical approaches, with encouraging outcomes.

In contrast to our findings, **Deschka *et al*. [8]** reported a 100% survival rate after ministernotomy in 50 patients who underwent aortoplasty or solitary replacement of ascending aorta or ascending aorta coupled with aortic valve replacement/reconstruction.

CONCLUSION

In certain individuals undergoing elective aortic root replacement surgery, a partial upper J-shaped sternotomy can be a safe and alternative approach. Unfortunately, further research is needed before this method can replace current best practises.

DECLARATIONS

Consent for publication: I attest that all authors have agreed to submit the work.

Availability of data and material: Available

Competing interests: None

Funding: No fund,

Conflicts of interest: no conflicts of interest.

REFERENCES

1. **Gaudino M (2015):** Contemporary outcomes of surgery for aortic root aneurysms: a propensity-matched comparison of valve-sparing and composite valve graft replacement. The Journal of Thoracic and Cardiovascular Surgery, 150(5):1120-9. e1.
2. **Abjigitova D (2018):** Current trends in aortic root surgery: the mini-Bentall approach. Innovations, 13(2):91-6.
3. **Elghannam M (2020):** Minimally invasive aortic root surgery: Midterm results in a 2-year follow-up. Journal of Cardiac Surgery, 35(7):1484-91.
4. **Charchyan E, Breshenkov D, Belov Y (2020):** Results of Minimally Invasive Valve-Sparing Aortic Root Valve Surgery: Propensity Score Matching Analysis. Kardiologiia, 60 (7):91-7.
5. **Mikus E (2017):** Mini-Bentall: an interesting approach for selected patients. Innovations, 12(1):41-5.
6. **Tabata M, Khalpey Z, Aranki S *et al*. (2007):** Minimal access surgery of ascending and proximal arch of the aorta: a 9-year experience. Ann Thorac Surg., 84:67-72.
7. **Totaro P, Carlini S, Pozzi M *et al*. (2009):** Minimally invasive approach for complex cardiac surgery procedures. Ann Thorac Surg., 88:462-7.
8. **Deschka H, Erler S, Machner M *et al*. (2013):** Wimmer Greinecker G. Surgery of the ascending aorta, root remodelling and aortic arch surgery with circulatory arrest through partial upper sternotomy: results of 50 consecutive cases. Eur J Cardiothorac Surg., 43:580-4.