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EDITORIAL

Minimal Access Aortic Root Surgery: An "Elite Sport" or Is it for Everyone?

Adam El Gamel, MBChB, MD, FRACS [a,b,c*]

[a]Waikato Cardiothoracic Unit, Waikato Hospital, Hamilton, New Zealand
[b]Faculty of Medical and Health Sciences, The University of Auckland, Auckland, New Zealand
[c]University of Waikato Medical Research Centre, The University of Waikato, New Zealand

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In this issue of *Heart, Lung and Circulation,* Harky et al. report a meta-analysis of the outcomes of Minimally Invasive Aortic Root Replacement (ie, via ministernotomy) in a relatively small, heterogeneous group of 2,765 patients [1]. Although they conclude that mini-sternotomy is a safe, feasible alternative option to full sternotomy in aortic root repair, it is vital to keep perspective about what we mean by the safety of a complex procedure done through minimal access, and not underplay the difficulties associated with this approach in subgroups of patients with significant aortopathy at a higher risk of complications. Cosgrove described the first minimally invasive valve surgeries in 1996 [2], followed by a few enthusiastic surgeons in reputable centres with high volume surgery. In the two decades since, minimally invasive cardiothoracic surgery (MICS) has flourished. This evolution has been propelled partially by a wish to benefit from many of the perceived MICS-advantages, mainly decreased pain and reduced surgical trauma.

Uneasiness around reduced surgical exposure, prolonged operative times, and jeopardised patient safety did temper a very early craze for MICS. However, enhancements in perfusion techniques, refinement of cardiothoracic imaging, mainly three dimensional (3D) echocardiography, and the development of specific MICS instruments, robotic technology [3], new suturing devices like Cor knot [4], and sutureless valve technology [5], has allowed industry to provide cardiac surgery with the essential means to progress to less invasive procedures. Although a great deal of the early writing on MICS centred on technical facets of small case series, and highlighted the safety and feasibility of MICS, questions remain regarding the relative efficacy of MICS over traditional sternotomy approaches [6].

As Iribarne et al. have said [3], carrying out surgery without adequate exposure prompted the development of alternative methods of cardiopulmonary bypass (CPB) access. Arterial cannulation can be achieved via the central aortic, or peripheral femoral or axillary artery. Several disadvantages have been highlighted with peripheral access, including an increased incidence of vascular complications and stroke [3,7], contrary to observations in studies that employ primarily central cannulation [3]. Venous drainage has posed difficulties and experienced numerous variations, with vacuum-assisted drainage directly via the right atrium or with bicaval access, either directly or percutaneously from the femoral or internal jugular veins. Similarly, myocardial protection with cardioplegia can be administered either antegrade from an aortic cannula or retrograde from the coronary sinus via trans-jugular catheterisation [8].

Further, in order to avoid the postoperative respiratory dysfunction, chest instability, chronic pain and incidence of deep sternal wound infection associated with a median sternotomy, cardiac surgeons evaluated numerous alternative incisions for MICS. Currently, as Iribarne et al. have written [3], minimally invasive aortic valve surgery is now most commonly performed via a limited skin incision, with a partial upper sternotomy that extends into the third or fourth intercostal space, and with many variations (Figure 1) [9–13].

However, the potential disadvantages of MIC-AVR have also been reported, namely that MIC-AVR is technically demanding with a limited surgical field, causing longer cross-clamp and CPB time, which in turn increase morbidity and mortality [8,11]. And, as Furokawa et al. have written, there is concern about the higher incidence of neurological

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*Correspondence to: Waikato Cardiothoracic Unit, Waikato Hospital, Pembroke St, Hamilton West 3204, New Zealand. Email: aelgamel@aol.com

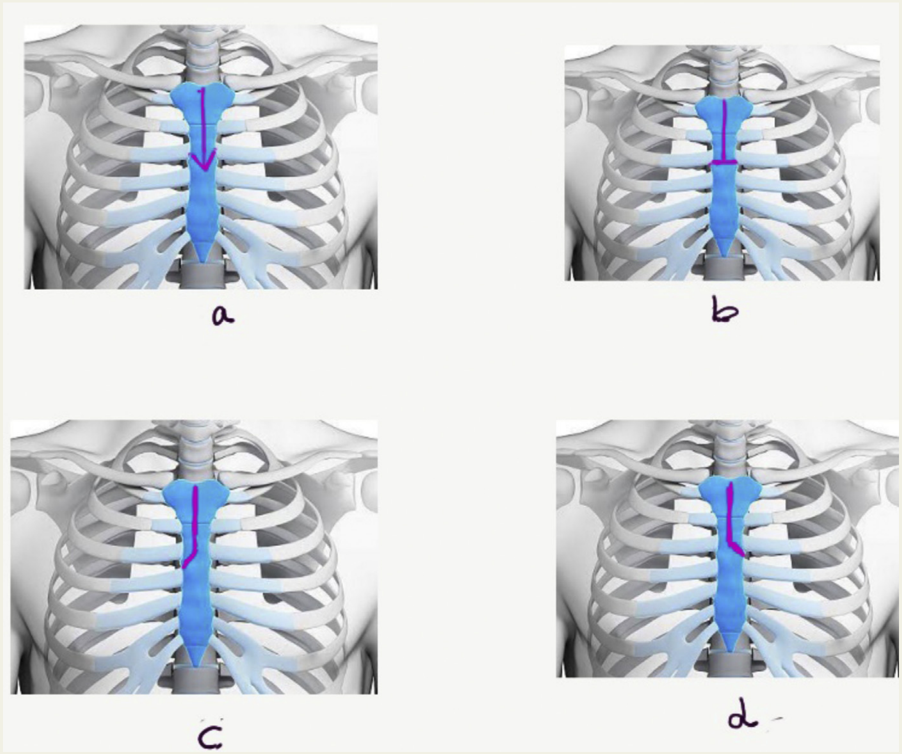

Figure 1 Common types of ministernotomy (a) inverted arrow, (b) inverted T, (c) inverted right J, (d) inverted left J.

complications caused by inadequate de-airing of the heart [14]. Add to the mix an aortic root procedure, and inherent difficulties increase unless you exclude bypass and the need for aortic valve intervention, such as with PEARS procedure [15]. Furokawa et al. reported that, in Tabata et al., the incidence rate of conversion from upper mini sternotomy was 2.6%, and the most common reasons were bleeding, ventricular dysfunction and inadequate exposure, and that the mortality rate of the converted cases was 33.3% [14,16]. Tabata et al. used a retrograde cardioplegia catheter placed into the coronary sinus through the right atrial appendage, placing the retrograde cardioplegia cannula with a restricted operative field is more challenging than via a full sternotomy [16]. Further, there is a probability of coronary sinus damage from this manoeuvre, leading to mandatory conversion to full sternotomy [16]. That conversions from ministernotomy are often associated with serious morbidity and mortality have not always been clearly stated in relevant analyses [17,18].

Although Harky et al. found that mini-sternotomy aortic root replacement was associated with significantly shorter cardiopulmonary bypass time [1], it is difficult to know why that would be the case, is this time related to surgical experience or surgical volume or case selection. The lower rate of blood transfusion and shorter intensive care unit and hospital stay have been common findings for MICS. These relatively modest benefits have to be weighed against the risks taken. Further, clearly the heterogeneity seen in patients is related to highly skilled surgical teams performing a complicated procedure with excellent outcomes in selected patients; this is reflected, clearly, in the lower operative mortality seen in the current analysis [1].

There has been a growth in the body of published literature on MICS long-term outcomes [3,19], with most reports suggesting that major cardiac operations that have traditionally been performed through a median sternotomy can be performed through a variety of minimally invasive approaches with equivalent safety and durability [20–22].

Overall, MICS marks wonderful progress for cardiac surgery, but currently it is an ''elite sport'' which needs lots of resources to be achieved safely; today, it is not safe in all hands. In the future, there will likely be a greater request for MICS approaches by patients seeking cardiac surgical options with reduced surgical trauma that allow for a faster return to normal activities and improved quality of life. In addition, MICS itself will continue to evolve in the future through the growing use of percutaneous technology, hybrid operating rooms and ongoing collaborations with interventional cardiologists [23]. One day there may be further progress in technology that would help the universal adoption of MICS by the generalist cardiothoracic surgeon.

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