

# Endoscopic cardiac surgery: the path less taken



Surgical specialties have changed the patient experience by introducing an endoscope to reduce surgical trauma and fasten recovery.<sup>1</sup> Cardiac surgery has been slow to adopt this approach even though initial efforts began nearly three decades ago.<sup>2</sup>

Technological advances introduced in recent years have led to a resurgence of interest in an endoscopic approach to cardiac surgery. In most cases, endoscopic procedures require the use of the femoral artery and vein to establish safe cardiopulmonary bypass. This is safer when done under transoesophageal echocardiography (TOE) guidance.<sup>3</sup> The more routine use of intra-operative TOE and the gradual, incremental improvements in the quality of images acquired has helped establish peripheral bypass safely and reproducibly in more centres. Alongside this, the introduction of three-dimensional endoscopic cameras with high-definition monitors has improved depth perception and assisted more surgeons in achieving accurate suture placement in technically challenging procedures like mitral valve repairs and aortic valve replacements. Robotic platforms have enabled surgeons to offer totally endoscopic valve procedures using the built-in 3D camera systems and articulating instruments that improve manual dexterity inside the bony chest cavity.

Avoiding splitting the sternum offers the advantage, to the patient, of earlier discharge from hospital after cardiac surgery, earlier functional recovery, and a reduced risk of sternal wound infections.<sup>4</sup> The cosmetic and psychological benefits of this approach are being increasingly studied and could have substantial implications on patient acceptance and preference of these less invasive procedures. With increasing experience, surgeons are becoming proficient in operating on the mitral, aortic, and tricuspid valves endoscopically, matching or improving the results achieved by a sternotomy. The endoscope is also helpful in dealing with congenital defects like atrial or ventricular septal defects,<sup>5</sup> arrhythmias requiring surgical therapy,<sup>6</sup> as well as rarer conditions like cardiac tumours<sup>7</sup> or resection of eccentric left ventricular septal hypertrophy.<sup>8</sup> The benefits to avoiding sternal re-entry to patients for second, third, or fourth procedures after previous sternotomies by an endoscopic approach also shows a lot of promise in expert centres.<sup>9</sup> The wristed instruments available on robotic platforms assist

cardiac surgeons in not only dissecting out the internal mammary artery conduits, but also in completing coronary artery bypass grafts totally endoscopically.

Despite the potential advantages of endoscopic cardiac surgery, wider adoption is limited in most health systems. International registries suggest that non-sternotomy approaches to heart surgery are on the rise,<sup>10</sup> though not all of these procedures are done endoscopically. Endoscopic mitral valve surgery and aortic valve replacements are limited to around 50–60 expert surgeons and well trained centres globally. There are many reasons why adoption of these techniques is slow. The capital costs for the equipment needed require increased funding. Unfortunately, there is no uplift in reimbursement, which prevents many hospital authorities from investing in it. In nationalised health systems where there are already long waiting lists for cardiac surgery procedures, there might not be much of an incentive for surgeons to take on a learning curve after over 10 years of training before appointment to an independent consultant job.<sup>11</sup> These challenges work as a disincentive for surgeons and centres to embark on learning new complex procedures which need a capital investment. Another limitation of this approach is that an endoscopic heart valve procedure does take longer to complete than a sternotomy, and a proportion of people might require conversion to a sternotomy for safe completion. However, the number of patients needing conversion to sternotomy does reduce with increasing experience.<sup>12</sup> The training needed to perform these procedures include simulation, cadaver laboratories, and training fellowships, all of which are in short supply.<sup>13</sup> In the UK, there is reduced funding available to support the adoption of new cardiac surgical techniques, with established charities like the British Heart Foundation spending over 95% of their research funds on cardiology-based research;<sup>14</sup> though in the USA cardiac transplantation research still attracts a lot of academic funding.<sup>15</sup> Furthermore, all surgical procedures are harder to be taught in an era where learning curves are less acceptable in society and time spent in surgical training is increasingly reduced.

Medium-term results with percutaneous trans-catheter procedures suggest that picking the right patient for the right intervention will be one of the most important



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challenges going forward, and a strategic equilibrium between interventional cardiology and cardiac surgery approaches has not yet been achieved. It will be important for heart teams to increasingly include patient characteristics and lifetime management concepts into decision making while considering patient preferences. There is wide variation in the use of trans-catheter options for heart valve disease across different health systems, which suggests that heart teams are influenced by the systems they work in.<sup>16</sup> Heart teams will be expected to appropriately triage patients towards the best treatment option to achieve durable outcomes in both the short term and long term management of cardiac diseases. We believe that an endoscopic or robotic approach needs to be made available in more cardiac surgery centres as a safe and effective alternative to the current options of sternotomy or trans-catheter interventions.

Global initiatives such as the Endoscopic Cardiac Surgeons Club are attempting to increase awareness of this procedure among referring physicians and patients while training the next generation of surgeons who will continue to offer these procedures worldwide. We believe the use of the endoscope with its better illumination, magnification, and recording ability will help with a faster dissemination of good surgical practice. However, the safe adoption of endoscopic cardiac surgery in many health systems will require a collaborative approach between industry, cardiac surgical societies, and national funding agencies to set up training units in already established centres. A network of surgeon mentors is needed to create a safe environment for wider adoption of these techniques, and for the assessment of the impact of these new techniques by regular research and audit projects following the IDEAL framework.<sup>17</sup> The benefits will not only be for patients but could also be more cost-effective for health systems due to reduced hospital stays and potentially reduced needs for re-interventions. The 2021 NICE guidelines in the UK support the idea that patients should first be considered for a minimally invasive heart valve procedure before considering other options,<sup>18</sup> which is in keeping with our vision. We hope in time, with appropriate training, an endoscopic cardiac surgery procedure will have an increased role in the surgical care of patients.

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- 1 Lee L, McLemore E, Rashidi L. Same-day discharge after minimally invasive colectomy. *JAMA Surg* 2022; **157**: 1059–60.
- 2 Stevens JH, Burdon TA, Peters WS, et al. Port-access coronary artery bypass grafting: a proposed surgical method. *J Thorac Cardiovasc Surg* 1996; **111**: 567–73.
- 3 Van Praet KM, Kofler M, Kempfert J. Cannulation techniques for cardiopulmonary bypass in endoscopic cardiac surgery. In: Zacharias J, ed. *Endoscopic cardiac surgery*. Springer: Cham, 2023: 245–254.
- 4 Akowuah EF, Maier RH, Hancock HC, et al. Minithoracotomy vs conventional sternotomy for mitral valve repair: a randomized clinical trial. *JAMA* 2023; **329**: 1957–66.
- 5 Dang QH, Le NT, Nguyen CH, et al. Totally endoscopic cardiac surgery for atrial septal defect repair on beating heart without robotic assistance in 25 patients. *Innovations (Phila)* 2017; **12**: 446–52.
- 6 Churyla A, Passman R, McCarthy PM, Kisilitsina ON, Kruse J, Cox JL. Staged hybrid totally thorascopic maze and catheter ablation for atrial fibrillation. *J Cardiovasc Electrophysiol* 2022; **33**: 1961–65.
- 7 Bianchi G, Margaryan R, Kallushi E, et al. Outcomes of video-assisted minimally invasive cardiac myxoma resection. *Heart Lung Circ* 2019; **28**: 327–33.
- 8 Casselman F, Vanermen H. Idiopathic hypertrophic subaortic stenosis can be treated endoscopically. *J Thorac Cardiovasc Surg* 2002; **124**: 1248–49.
- 9 Abdelbar A, Knowles A, Zacharias J. Fourth cardiac procedure: redo endoscopic mitral surgery for a stuck leaflet. *Innovations (Phila)* 2024; **19**: 124.
- 10 Doenst T, Berretta P, Bonaros N, et al. Aortic cross-clamp time correlates with mortality in the mini-mitral international registry. *Eur J Cardiothorac Surg* 2023; **63**: ead147.
- 11 Joffe M, Hunter S, Casula R, et al. Adoption of minimally invasive mitral valve surgery in the National Health Service: a blend of science, psychology and human factors. *Interdiscip Cardiovasc Thorac Surg* 2023; **36**: ivad028.
- 12 Kirmani BH, Knowles A, Saravanan P, Zacharias J. Establishing minimally invasive cardiac surgery in a low-volume mitral surgery centre. *Ann R Coll Surg Engl* 2021; **103**: 444–51.
- 13 Reznick RK, MacRae H. Teaching surgical skills—changes in the wind. *N Engl J Med* 2006; **355**: 2664–69.
- 14 UK Clinical Research Collaboration. UK Health Research Analysis 2022. 2023. <https://hrcsonline.net/reports/analysis-reports/uk-health-research-analysis-2022/> (accessed July 23, 2024).
- 15 Narahari AK, Mehaffey JH, Chandrabhatla AS, et al. A 30-year analysis of National Institutes of Health-funded cardiac transplantation research: surgeons lead the way. *J Thorac Cardiovasc Surg* 2021; **162**: 1757–1765.e1.
- 16 van Bakel PAJ, Ahmed Y, Hou H, et al. Geographic variation in aortic stenosis treatment and outcomes among Medicare beneficiaries in the United States. *Catheter Cardiovasc Interv* 2024; **103**: 490–98.
- 17 McCulloch P, Feinberg J, Philippou Y, et al. Progress in clinical research in surgery and IDEAL. *Lancet* 2018; **392**: 88–94.
- 18 National Institute for Health and Care Excellence. Heart valve disease presenting in adults: investigation and management NICE guideline [NG208]. Nov 17, 2021. <https://www.nice.org.uk/guidance/ng208> (accessed July 26, 2024).

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