SHORT COMMUNICATION

A propensity score–adjusted comparison of thoracoscopic periareolar and video-assisted approaches for minimally invasive mitral valve surgery

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Introduction Minimally invasive mitral valve surgery (MIMVS) is now a widely accepted alternative to the standard sternotomy approach and its benefits have been proven.[1,2] Right lateral video-assisted minithoracotomy remains the most frequently used access method for MIMVS and is associated with reduced injury, blood loss, and need for transfusion, as well as shortened hospital stay and rehabilitation time.[3,4] To further reduce surgical trauma and improve cosmetic results, the use of the fully thoracoscopic periareolar (TP) access for mitral valve surgery has recently been proposed and introduced with excellent outcomes.[5,6] Research on the TP technique is scarce. Our study is the first to compare these 2 minimally invasive techniques.

Methods **Study population** Our study involved 178 consecutive patients undergoing cardiac surgery between 2011 and 2016 because of mitral valve disease and included in the prospective, single-center all-comer registry. Patients undergoing a surgery performed with the use of a minimally invasive technique were retrospectively divided according to set time frames: the first 130 patients were operated via right-sided video-assisted minithoracotomy, whereas the next 48 patients were treated using the TP approach upon its introduction in the Department of Cardiac Surgery, Central Clinical Hospital of the Ministry of the Interior and Administration, Centre of Postgraduate Medical Education, Warsaw, Poland, in 2015.[7] The assessed endpoints included in-hospital death, stroke, need for chest reoperation due to bleeding, and prolonged mechanical ventilation over 24 hours. Additionally, 5-year follow-up data were collected. The study was approved by the institutional review board. All patients provided written informed consent to participate in the study.

Thoracoscopic periareolar access The thoracoscopic periareolar access was achieved through a periareolar incision around the right nipple.[7] After thoracotomy in the 4th intercostal space had been performed, a small, soft tissue silicone retractor was introduced into the patient's body. A thoracoscope and a Chitwood clamp were introduced through additional ports (FIGURE 1B). The endoscopic view was obtained using a standard 10-mm endoscope with a variable angle of view (EndoCAMeleon, KARL STORZ GmbH & Co. KG, Tuttlingen, Germany) or a 3-dimensional view system (EinsteinVision 3.0, B. Braun, Tuttlingen, Germany).

Video-assisted minithoracotomy access The skin incision was performed over the 4th intercostal space, along the anterior axillary line.

FIGURE 1 **A**, **B** – setup in video-assisted (**A**) and thoracoscopic periareolar (**B**) approaches for minimally invasive mitral valve surgery; **C**, **D** – cosmetic results after mitral valve surgery performed with the use of video-assisted (**C**) and thoracoscopic periareolar (**D**) approaches. Written consent to use photographs that may identify the people was obtained.

A standard soft tissue silicone retractor was used. Similarly, both thoracoscope and Chitwood clamp were introduced through additional ports (FIGURE 1A). During the procedure, video and direct views were used interchangeably, depending on the phase of the operation and operating field conditions.

Statistical analysis Continuous, normally distributed variables were expressed as mean (SD), and variables with non-normal distribution, as median (interquartile range [IQR]). Propensity score analysis was performed to balance possible confounding between the 2 study groups regarding selected variables in order to avoid any bias related to the initial selection of patients for MIMVS surgery. Regression adjustment was then applied and resulted in improved precision for the continuous outcome, as described by Steyerberg.[8] The STATA MP v13.0 software (StataCorp, College Station, Texas, United States) was used for calculations.

Results and discussion

Preoperative comparison Preoperatively, both study groups did not differ significantly in terms of age (65.4 vs 64.3 years), comorbidities, ejection fraction (52% vs 54%), or operative risk. Significantly less women were operated via the TP access (8 [17%]) compared with the video-assisted approach (66 [51%]) (P = 0.01). The median (IQR) EuroSCORE II was 3.6 (2.1–6.3) and 4.6 (2.4–9.3) in the TP and video-assisted groups, respectively. Atrial fibrillation was diagnosed in 103 patients (57.9%). Isolated mitral valve regurgitation was noted in 81.2% of the study patients, mitral valve stenosis in 18.8%, and concomitant functional tricuspid regurgitation in 28.6%.

Surgical characteristics Mitral valve repair was a preferred approach, followed in all patients with regurgitation. The polytetrafluoroethylene loops and annuloplasty rings were used in all mitral valve repair procedures. Mitral valve replacement was performed in all patients with mitral valve stenosis (21 [11.8%]). Tricuspid valve repair was conducted in 45 patients (28.6%). Additionally, all patients with atrial fibrillation (57.9%) underwent endocardial ablation. Conversion to full sternotomy was not required in any patient. No conversion from the TP access to the video-assisted approach was necessary. There was no significant difference in the median (IQR) total blood loss between the TP and the video-assisted groups (355 [220–540] ml vs 330 [250–520] ml; P = 0.8). The median (IQR) aortic cross-clamp time did not significantly differ between the 2 study groups (94 [80–130] min and 90 [68–121] min in the TP and video-assisted groups, respectively; P = 0.7). The median (IQR) time of stay in the intensive care unit also did not differ between both groups (3.5 [2–6] days and 2 [1–4] days in the TP and video-assisted groups, respectively; P = 0.4).

Postoperative complications There was no significant difference in terms of in-hospital mortality between the TP and video-assisted groups (1 [2.1%] vs 4 [3.1%]; P = 0.7). Stroke occurred after the surgery in 3 patients (2.3%) from the video-assisted group (P = 0.5). No difference was found in the median (IQR) postoperative mechanical ventilation time between the study groups (3.5 [3–6.5] vs 6.5 [4–15] hours in the TP and video-assisted groups, respectively; $P = 0.9$). No wound healing disorders or lymphoceles were observed.

Follow-up In the video-assisted group, the overall 5-year survival rate was 96.2%, and freedom from reoperation was estimated at 98.5%. The overall survival rate in the TP group was 94.3% at follow-up and did not demonstrate a significant difference compared with the video-assisted group (hazard ratio [HR] [95% CI], 0.71 [0.08–6.39]; $P = 0.8$). Neither did the comparison of freedom from reoperation: 97.8% in the TP group (HR [95% CI], 3.05 [0.19–48.95]; $P = 0.4$).

Propensity adjustment One-to-one propensity score–matched analysis resulted in 45 pairs with similar baseline characteristics. A propensity score–matched HR for overall survival between the TP and video-assisted approaches adjusted for age, sex, left ventricular ejection fraction, and EuroSCORE II was estimated at 0.74 (95% CI, 0.06–6.56; $P = 0.7$).

Conclusions In conclusion, this is the first report to compare the safety and feasibility of these 2 minimally invasive techniques in mitral valve surgery. Both techniques were associated with similar mortality, stroke, and repair rates. A longer cross-clamp time in the TP approach compared with the video-assisted one was nonsignificant. Our findings endorse the endoscopic approach as the next step in the evolution of mitral valve surgery, yet we see no contraindications to expanding the TP approach beyond mitral valve surgery.

Although any means of MIMVS offers several benefits, a smaller access site and a better cosmetic effect are among the advantages of the thoracoscopic approach (FIGURE 1C and 1D). As the entire surgery is mainly performed "on the screen," not using a direct view, rib-spreading manoeuvres (especially when using a metal spreader) are excluded, which significantly reduces postoperative pain.[2,4] Paradoxically, the thoracoscopic access may ensure a better, easier, and quicker exposure in obese patients and individuals with "difficult" operative anatomy, including deeper structures such as the subvalvular apparatus or the ventricular septum. Furthermore, the thoracoscopic setting, being less dependent on operative conditions, enables a surgeon to operate in a healthier body position.[6]

In our experience, the currently used 3-dimensional optics provides the surgeon with a better sense of the working space, especially improving visual depth perception. Compared with 2-dimensional systems, the 3-dimensional optics facilitates the performance of complex and precise movements with the use of long-shafted instruments and the actual distance assessment, particularly when it comes to examining the structures localized parallel to the surgeon's visual axis. This may be of value, for example, when measuring the proper length of natural chords, polytetrafluoroethylene loops, or neochords in the subvalvular apparatus.[7] It can be beneficial in asymptomatic patients and cause reverse remodeling.[9]

We found that this approach can be safely used in male patients, and exceptions may be made in some women with small mammary glands. Although reports on consecutive female patients undergoing TP can be found,[10] in our opinion, the approach should not be recommended to all women, since it requires mammary gland preparation and, as a consequence, hinders proper intercostal space selection.

ARTICLE INFORMATION

CONFLICT OF INTEREST None declared.

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