Editorial

The role of robotic coronary artery bypass grafting in the current practice of surgical myocardial revascularization

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The field of coronary artery bypass grafting (CABG) has evolved significantly, giving rise to refined techniques and improved patient outcomes (1). The introduction of minimally invasive techniques, starting with minimally invasive direct coronary artery bypass grafting (MIDCAB) and advancing to robotic MIDCAB and totally endoscopic coronary artery bypass grafting (TECAB), has further revolutionized the field of cardiac surgery (2). These minimally invasive techniques address the limitations of traditional CABG by enabling surgery through small incisions without the use of cardiopulmonary bypass, offering reduced trauma, shorter hospital stays, and faster recovery. Furthermore, the integration of these minimally invasive methods with interventional techniques in hybrid coronary revascularization (HCR) strategies has amalgamated the benefits of both approaches (3).

Surgical revascularization using internal mammary arteries (IMAs) has demonstrated superior long-term patency and improved survival compared to percutaneous coronary intervention (PCI) in stable coronary artery disease (4). Robotic MIDCAB offers the potential for enhanced precision, dexterity, and visualization, facilitating more intricate anastomoses and potentially improving long-term graft patency, thereby contributing to improved patient outcomes (5).

Despite the potential advantages of robotic MIDCAB, there have been several challenges that hinder its widespread adoption. These include the high initial and procedural cost of robotic systems, the need for specialized expertise, and the unjustly feared learning curve associated with these techniques. Nevertheless, research has indicated that outcomes can significantly improve when working with a well-trained team, following standardized procedures, and adopting the right approach (6). Despite these obstacles, the number of centers with robotic programs is steadily increasing (7).

Heart team discussions play a crucial role in evaluating individual patients and determining the most appropriate treatment approach. By facilitating meaningful interdisciplinary discussions, patients can benefit from the combined expertise of both specialties. The presence of a robotic MIDCAB program in surgical departments lays a solid foundation for collaborative hybrid revascularization procedures with cardiologists (8). Robotic MIDCAB presents an opportunity for cardiologists to assess patients who may not be suitable for traditional cardiac surgery for robotic MIDCAB or hybrid coronary revascularization. This allows for more comprehensive revascularization across a wider spectrum of patients. Specifically, robotic MIDCAB with IMA to left anterior descending artery (LAD) may offer advantages over PCI for isolated LAD lesions, particularly in younger individuals or cases requiring longer stents,

which pose a higher risk of restenosis (9). Additionally, robotic MIDCAB can complement PCI in addressing multivessel coronary artery disease, leading to personalized and optimal treatment strategies. HCR, especially when combining robotic MIDCAB with PCI, presents a superior approach in cases where certain vessels are not optimal targets for surgical revascularization (3). This combined strategy enables full revascularization by allowing for PCI of vessels that may pose challenges for traditional surgical intervention. By combining the accuracy and flexibility of PCI with the enduring patency of IMAs used in robotic MIDCAB, complete and durable revascularization can be achieved, potentially leading to improved outcomes. In the context of urgent non-ST-elevation or ST-elevation myocardial infarction cases, there exists the potential for additional benefit through a dual strategy involving immediate PCI to address the non-LAD culprit lesion during the ischemic event, followed by subsequent complete revascularization of the LAD lesion using robotic MIDCAB on a longer-term basis. This approach not only addresses the acute ischemic event promptly but also provides a pathway for comprehensive and durable revascularization through robotic MIDCAB, potentially contributing to improved long-term outcomes for these high-risk patients. Furthermore, HCR involving robotic MIDCAB provides an opportunity for optimal revascularization in patients with severe coronary artery disease, advanced age, or comorbidities that render them unsuitable for high-risk CABG surgery involving a median sternotomy. Patients at the highest risk of mortality with conventional CABG have shown considerable benefits from off-pump CABG due to the reduced physiological stress it imposes, such as less systemic inflammation and haemodilution, compared to CABG performed on cardiopulmonary bypass (10,11). Robotic MIDCAB, with its minimally invasive approach, further mitigates physiological stress and inflammation associated with surgery, providing additional benefits for these high-risk patients. This approach extends optimal care to the most vulnerable patients, including those awaiting transcatheter valve intervention, individuals with chronic kidney insufficiency and moderate coronary artery disease involving the proximal LAD, as well as morbidly obese patients at a heightened risk of postoperative sternotomy complications. The emphasis on rapid postoperative recovery is particularly significant in these cases, and minimally invasive/hybrid revascularization demonstrates substantial benefits in achieving swift extubation, reducing postoperative pain, shortening hospital stays, and facilitating prompt rehabilitation.

In conclusion, robotic MIDCAB holds immense potential in the realm of HCR, offering a minimally invasive approach with the potential for improved patient outcomes. However, current guidelines lack specific recommendations for robotic MIDCAB and HCR, and differences exist between European and American guidelines. It is imperative to consider implementing recommendations for HCR with robotic MIDCAB in future guidelines to ensure standardized and evidence-based approaches to myocardial revascularization. As technological advancements progress and collaborative efforts between surgery and interventional medicine strengthen, the future of robotic MIDCAB in hybrid revascularization strategies appears promising.

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Footnote

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