



Aortic arch open surgery: countdown started or timeless approach?

Luca Di Marco^{1,2}, Roberto Di Bartolomeo³

¹Cardiac Surgery Unit, Cardio-Thoraco-Vascular Department, IRCCS Azienda Ospedaliero-Universitaria di Bologna, Bologna, Italy; ²Department of Medical and Surgical Sciences, DIMEC, Alma Mater Studiorum-University of Bologna, Bologna, Italy; ³Alma Mater Studiorum-University of Bologna, Bologna, Italy

Correspondence to: Prof. Luca Di Marco, MD, PhD. Cardiac Surgery Unit, Cardio-Thoraco-Vascular Department, IRCCS Azienda Ospedaliero-Universitaria di Bologna, Via Giuseppe Massarenti 9, Padiglione 23, Bologna 40138, Italy; Department of Medical and Surgical Sciences, DIMEC, Alma Mater Studiorum-University of Bologna, Bologna, Italy. Email: luca.dimarco4@unibo.it.

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Introduction

From the pioneering era of cardiovascular surgery, led by legendary figures such as Michael DeBakey and Denton Cooley (1), the management of complex aortic diseases has exemplified the highest ideals of medicine: technical mastery, bold innovation, and profound respect for human life. Among the most challenging territories they helped define is the aortic arch—a delicate, curved structure that directs blood from the heart to the brain and the rest of the body. For decades, open aortic arch surgery has stood as a symbol of surgical excellence, demanding precision, endurance, and judgment under extreme conditions, while simultaneously representing, in most cases, the “Achilles’ heel” for the cardiac surgeon.

A landmark moment in the history of aortic surgery came in 1987, marking what can rightly be considered a true “aortic revolution”. Russian surgeon Nicolai Volodos performed the first-ever treatment of a patient with aortic disease using a stent graft designed by him and his team, which included his son, Sergiy Volodos (2). From that point onward, endovascular technology and approaches began to spread steadily in the management of aortic pathology. Today, open aortic arch surgery, for a long time the dominant approach, faces a critical question: “*Is open aortic arch surgery gradually being replaced by newer, less invasive techniques, or does it retain a lasting and irreplaceable role?*” The answer depends not only on clinical outcomes but also on a deeper

understanding of how innovation interacts with tradition in medicine. Modern cardiovascular care is increasingly shaped by minimally invasive strategies, particularly endovascular procedures. These techniques, performed through catheters and small incisions, have transformed the patient experience, often reducing operative trauma, shortening recovery times, and lowering immediate risks. For many patients—especially those considered high-risk for conventional surgery—these advances have expanded therapeutic options. This potential benefit is also reflected in patient-reported outcomes. In a retrospective pilot study, Lim *et al.* compared open aortic arch surgery with endovascular aortic arch repair in 12 patients using the RAND SF-36 questionnaire six weeks after surgery (3). Patients treated with the endovascular approach reported better quality of life with significantly less postoperative pain than those undergoing open surgery. However, because the study was small, non-randomized, and underpowered, most differences did not reach statistical significance. These preliminary findings suggest that endovascular aortic arch repair may offer improved short-term quality of life, particularly with respect to postoperative pain, while highlighting the need for larger prospective studies before definitive conclusions can be drawn.

This rapid evolution has contributed to the perception that open surgery may be becoming obsolete. Healthcare systems, driven by efficiency and cost-containment imperatives, often favor approaches that reduce hospital

stays and resource utilization. Consequently, aortic arch surgery can appear outdated: complex, demanding, and reliant on highly specialized skills that are becoming increasingly rare. However, framing innovation merely as a replacement of the old with the new risks oversimplifying the reality. Progress in medicine often entails the redefinition of roles rather than their elimination. However, viewing innovation simply as the replacement of the old with the new risks oversimplifying reality. Advances in the medical field often involve a redefinition of roles rather than their elimination. Looking at things from this perspective, one might therefore consider applying the aphorism ‘never abandon the old path for the new one’, which encourages us not to give up what we know and what has already borne fruit. This is a message that urges us to maintain familiarity and security, even if we are forced to set out on a new path. This aphorism emphasizes the importance of not losing the experience we have accumulated and of continuing to walk along the paths we have always taken. However, can this view still be considered relevant, or do we have to push further and further towards innovation at the expense of the much-loved ‘open surgery’?

Despite remarkable advances in endovascular technologies, their application to the aortic arch remains limited by significant anatomical and technical challenges (4-7). The curvature of the vessel, its proximity to the brain, and the involvement of critical arterial branches require extraordinary precision. Even minor errors can result in devastating neurological consequences (8,9). Open surgery, while more invasive, offers advantages that newer techniques still struggle to fully replicate. Direct visualization of the anatomy allows meticulous reconstruction and immediate correction of unexpected events. This level of control contributes to long-term durability, a crucial consideration particularly for younger patients or those with complex pathology. This creates a central tension: while innovation emphasizes simplicity and minimal invasiveness, the biological complexity of the human body resists such simplification. It is within this resistance that the enduring relevance of traditional surgery resides. Moreover, beyond technical considerations, aortic arch surgery demands not only manual skill but also clinical judgment, adaptability, and a willingness to confront uncertainty directly. Each procedure is unique, requiring the surgeon to interpret subtle anatomical variations and make real-time decisions with significant consequences.

In contrast, endovascular approaches emphasize standardization and efficiency, relying on devices and protocols

designed to ensure reproducible results. While this is an advantage, it can also shift focus away from the interpretive aspects of surgical practice.

As endovascular procedures become more widespread, the number of open aortic arch surgeries is declining in many centers (6,10). This trend has important implications for surgical training. Mastery of traditional techniques requires years of experience, exposure to complex cases, and mentorship from expert surgeons. If opportunities for hands-on learning decrease, new generations of surgeons may fail to acquire essential skills. This could create gaps in care, particularly in cases where minimally invasive techniques are insufficient or when complications require traditional surgical intervention.

From an ethical standpoint, a critical question arises: can medicine—and cardiac surgery in particular—afford to lose certain skills simply because they are less frequently used? Or does it have a duty to preserve them as part of a complete and resilient healthcare system?

Rather than framing open and endovascular surgery as competing approaches, it is more accurate to view them as complementary. Hybrid procedures, combining elements of both, already demonstrate how these strategies can be integrated to achieve optimal outcomes.

The future of aortic arch treatment will likely be personalized, based on patient characteristics, disease complexity, and institutional expertise. In this context, open surgery does not disappear but rather becomes specialized, reserved for cases in which its advantages are clear. Defining open aortic arch surgery as “timeless” does not imply immutability. Its enduring value lies in its ability to address fundamental challenges—anatomical complexity, variability, and high-stakes decision-making—that persist irrespective of technological advances.

Timeless approaches in medicine are those that retain their relevance even as the context changes. Open surgery continues to provide solutions in situations where other techniques may be insufficient. At the heart of this discussion is always the patient. Each aortic arch pathology represents a unique scenario. For some patients, minimally invasive techniques are the best option; for others, open surgery remains the only effective and durable solution.

Reducing this complexity to a single narrative risks overlooking the very nature of medicine, which requires flexibility and personalization. Additionally, open surgery preserves a profoundly human dimension: direct engagement, focus, and responsibility.

Conclusions

Open aortic arch surgery is not destined to disappear; rather, it is evolving. Even if its frequency declines, its role will remain essential in the most complex cases.

This is less a countdown to obsolescence than a transition toward equilibrium. In this landscape, the legacy of De Bakey and Cooley reminds us that progress is not only about adopting new technologies, but about integrating them with enduring principles of skill, judgment, and patient-centered care.

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Footnote

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