# PERSPECTIVE

# Robotic laparoscopic vascular surgery techniques

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**ABSTRACT**

Vascular surgery is a subject that is continually developing and is unmatched in terms of innovation and embracing new technologies. The way that aneurysms and occlusive diseases are treated has fundamentally changed as a result of endovascular therapy. It is crucial that the vascular community continue to be at the vanguard as we make strides in endovascular therapy, robotic surgery, artificial intelligence, and minimally invasive surgery. The advantages of robotic vs laparoscopic aortic surgery, patient eligibility for robotic-assisted aortic surgery, and strategies for increasing training and implementation of robotic-assisted laparoscopic aortic surgery are among the topics covered. Future development will involve the construction and validation of curriculum and virtual simulators, the introduction of new platforms and technologies, and the execution of randomised clinical trials to ascertain the most effective uses of robotics in vascular surgery.

**Key Words:** *Anomia; Occult breast cancer, Surgical care, Prophylactic antibiotic.*

## INTRODUCTION

The word "robot" was originally used in 1920 by Czech playwright Karel apek in his play Rossumovi Univerzaini Roboti [1]. 35 years ago, the use of robots in medicine began. The necessity for accuracy in surgical techniques during minimally invasive surgery gave rise to the use of robots in surgery. With remote manipulators controlled by a surgeon at a surgical workstation, the da Vinci Surgical System (Intuitive Surgical), which was founded in 1995, currently makes use of robotics in surgery more widely than any other system. Despite the lack of haptic feedback, robotic surgery's technical benefits have allowed it to overcome many of the drawbacks of conventional laparoscopic surgery. The robotic platform is thought to have fundamental advantages such as three-dimensional (3D) vision, EndoWrist instruments, steady and magnified pictures, physiologic tremor filtering, and motion scaling. Since the introduction of the da Vinci Surgical System, robotic-assisted surgery has established its viability and safety in a wide range of surgical specialties all over the world. However, challenges to its adoption as the conventional surgical procedure include greater costs and a lack of clinical research, particularly in the early stages of robotic program development. The development of numerous alternative surgical procedures is a result of the hunt for less intrusive treatment approaches. Endovascular, laparoscopic, and robot-assisted laparoscopic surgical procedures have been developed and are at the forefront of minimally invasive innovations in vascular surgery. With significant advantages over open aortic surgery, the endovascular intervention has received extensive study and adoption among the vascular community at large. Laparoscopic vascular surgery has undergone a major change as a result of surgical robotic devices. Robots eliminate the challenging laparoscopic instrument manipulation that causes prolonged aortic clamp time and vascular anastomosis repair. Vascular anastomosis can be carried out more quickly and simply with robotic assistance than with traditional laparoscopic surgery. During an aortofemoral bypass, a local aortic endarterectomy can also be performed with ease using the robotic system. The majority of younger, non-obese patients without cardiovascular conditions, adequate aortic neck architecture for AAA, and low calcifications for aortofemoral surgery were chosen as candidates at the outset of the robotic aortic program development. The pool of qualified candidates for surgeries aided by robotics is constantly expanding as a result of the surgical team's growing

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experience. The main contraindication of obesity has been eliminated. The aortofemoral bypass procedure is currently. Experience in laparoscopic vascular surgery can undoubtedly be of some added value, but the basic laparoscopic experience is a very good foundation for beginning a robotic aortic program. Unfortunately, laparoscopic or thoracoscopic surgery is a field in which the majority of cardiovascular surgeons have little to no training. A successful robotic aortic program requires intense interest, excellent laparoscopic and robotic preparation, and arduous training. Over the past ten years, the da Vinci Surgical System has been used for several vascular procedures. The numerous forms of robotic-assisted vascular surgery are listed below. Vascular surgery adopted laparoscopy considerably later than other fields did. The difficulty in suturing the vascular anastomosis, prolonged clamping times, and challenges in gaining access to the aorta and pelvic arteries were the principal deterrents to laparoscopic vascular surgery. Vascular laparoscopic procedures would rank exceedingly high on a hypothetical scale of difficulty. By minimising operating trauma, laparoscopic surgery promotes quicker recovery. In vascular surgery, particularly aortic repair combines minimally invasiveness with long-lasting outcomes from traditional surgery. The first laparoscopic vascular surgery, an aortic-bifemoral bypass with laparoscopic assistance, was performed in 1993. New methods and techniques have been created since then, and an increasing proportion of patients have received a successful outcome. These techniques include wholly laparoscopic, aided laparoscopic, and hand-assisted laparoscopic procedures. Nevertheless, there aren't many published clinical trials and even fewer series on laparoscopic abdominal aortic aneurysm repair. As a minimally invasive method with low morbidity and mortality, it competes with endovascular aneurysm repair and seems to be more challenging than bypass surgery. Laparoscopic aortic surgery did not become widely popular due to the rapid development of endovascular procedures, primarily because of the technical difficulties, difficulty learning the necessary skills, especially for vascular surgeons who were not experienced with laparoscopic surgery, and the consequently lengthy recovery period. However, another potential option for minimally invasive vascular surgery is robot-assisted laparoscopic surgery. It overcomes the limits of laparoscopy and provides more precision and control in restricted locations as well as a faster learning curve. A less intrusive option for aneurysm repair, bypass surgery for aortoiliac occlusive disease, or secondary procedures following EVAR is laparoscopic or RA-(laparoscopic) surgery.

An aorto-bifemoral bypass became the first to use robot-assisted laparoscopy in vascular surgery. A few case studies from a small number of facilities around the world reported outcomes of robot-assisted laparoscopic surgery in the aortoiliac area. The technological complexity of the robotic equipment is largely to blame for the lengthier operating time in whole robot-assisted procedures. Robotic devices have been used in reconstructive arterial surgeries like the correction of renal and splenic artery aneurysms in addition to infrarenal aortic diseases. Other pathologies were treated as endovascular procedure complications, such as a type II end leak that persisted after EVAR with robotic inferior mesenteric artery ligation and thoracoabdominal aortic aneurysms treated with a combination of surgical debranching and endovascular repair, but overall cases were few. Regarding the overall clinical advantages of robot-assisted laparoscopic surgeries, however, there are mixed findings. According to several articles, outcomes from robotic surgery in several disciplines are on par with or even better than those from laparoscopic surgery. Surgeons from all around the world have demonstrated the viability and safety of performing a variety of robot-assisted procedures, reporting that the results are on par with those of laparoscopic surgery. Robotic technology has proven to be more advantageous for operations in small spaces, like colorectal and esophageal surgery. However, a meta-analysis comparing robotic and traditional laparoscopic gastric bypass in bariatric surgery found longer operating times rather than any changes in mortality. According to a Cochrane database analysis, there is no high-quality evidence that RA-assisted prostatectomy is superior to laparoscopic or open surgery in terms of oncological outcomes, postoperative complication rates, or postoperative discomfort. Similar outcomes were obtained by a controlled, randomised multicenter research comparing RA-laparoscopic surgery for rectal cancer with traditional laparoscopic surgery. As of now, there is a lack of high-quality data from randomised trials in vascular surgery as it is only available from individual case studies from a small number of facilities globally. The da Vinci system might not be authorised for use in this particular medical profession as one possible explanation. The team of Stadler et al., who have the largest case series processes and perhaps the broadest experience in this area, is an exception.

Robotic surgery, as previously indicated, has drawbacks, chiefly in that it is more expensive than standard operations and that there is still a learning curve, restricting its application to too few locations globally. Robot-assisted laparoscopic operations failed to make a strong impression in vascular surgery due to competition from a developing endovascular area. They can still increase the treatment possibilities, though. Endovascular procedures have better immediate clinical and financial results than open operations for the treatment of aortoiliac occlusive disease. Multiple treatments can be carried out during the same surgery, they are less intrusive, and they are better suited to high-risk patients. Cardiology was where robotic cardiac ablation and mapping for arrhythmias first gained experience with robotic-controlled catheter systems. Initially described as the first robotic-assisted percutaneous coronary intervention pilot research. A remote workspace and a table-side robotic device make up the two-part master and slave CorPath system. The table-side robotic unit is made up of an articulating arm and a robotic drive that houses a single-use cassette that moves the guidewires and fast exchange catheters, while the distant workspace is essentially a radiation-shielded mobile workstation. For individuals with symptomatic and asymptomatic carotid artery stenosis, multiple authors have established the viability and safety of carotid artery stenting.

The initial outcomes of RA-endovascular treatments are really encouraging. Robotic endovascular navigation still has certain limitations, though. Each method requires a system setup period, and additional personnel training is required. However, compared to traditional endovascular techniques, robotic endovascular surgery is significantly simpler to learn, as shown by a number of in vitro trials. Endovascular robotic technologies, like RA-laparoscopic surgery, lack haptic control and may thus put vascular health at risk. Currently, some devices must be manually installed because specific materials, such as guidewires, cannot be used with endovascular robotic

platforms. The longer-term health benefits for the employees and the patient's safety must be taken into account, notwithstanding the greater expenditures for the robotic system and the disposable cassette. The benefits of robotic endovascular surgery over traditional procedures include quicker process times and fluoroscopic exposure times, better catheter tip stability, and better control over catheter movements. The technology is incredibly steady to perform submillimeter movements once it has arrived at the desired place. The potential for performing remote surgical procedures was the initial purpose of developing robotic surgical platforms. This is especially true now that a large portion of the population cannot access healthcare due to the geographic spread of highly specialised healthcare. Remotely located patients and surgeons can connect via telesurgery using wireless networks and robotic technologies. In Strasbourg, France, a female patient underwent the first telesurgery in history, known as "Operation Lindbergh," using a ZEUS robotic system. Up until now, additional clinical investigations have shown its viability in both interventional vascular surgery and interventional cardiology in vitro. However, telerobotic processes are currently more experimental in nature and far from being fully operational. The main difficulties are the lag time, which delays auditory and visual information and increases the risk of surgical error and patient safety. During the process, a reliable high-speed data connection is required. Additionally, there are financial and legal considerations for performing remote surgeries at various medical facilities. Surgery may benefit from robotic technology since it increases human skills. A robotic system enables actions that are not possible with conventional surgery by allowing doctors to scale their movements into micromotions, eliminating bodily tremors, and improving vision. Numerous laparoscopic vascular reconstructions, including those of the abdominal aorta, visceral arteries, and iliac arteries, have been performed using robotic surgery. However, only a few facilities globally conducted the majority of these procedures, and only the busiest centers reported significant datasets. The fact that there is a large, established endovascular sector is one of the reasons why it has not been widely adopted in the vascular community. However, it may still offer a minimally invasive surgical alternative in situations when endovascular therapy fails or in complex aortic disease treatment as hybrid operations. On the other hand, there is a transformation happening in endovascular surgery. Even in difficult anatomical conditions, the effectiveness of endovascular robots has been demonstrated in PAD, CAS, FEVAR, transfemoral renal, and mesenteric procedures. Robotic peripheral vascular procedures have been demonstrated in clinical trials to be feasible, safe, and to lessen risks for both patients and operators, such as radiation exposure. To completely integrate that promising new technology into the clinical setting, additional technological breakthroughs are required, such as improvements in steerability and haptic feedback as well as interoperability with current devices. The adoption of this technology for remotely performed procedures like stroke thrombectomies is in the near future. Still, there are certain restrictions. Only a few observational studies or case reports from a small number of centers around the world have been published to date, proving the viability and security of robot-assisted endovascular treatments. Due to a dearth of controlled randomised trials, a reliableassessment of its long-term superiority to traditional endovascular methods is not feasible.