

Revolutionizing vascular surgery: Tech, ai, therapies.

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Introduction

Robotic-assisted vascular surgery has emerged as a promising advancement, supported by systematic reviews and meta-analyses. These studies indicate its strong feasibility and safety in clinical application. This innovative approach is particularly valuable for overcoming traditional technical limitations, thereby potentially enhancing surgical precision and significantly reducing surgeon fatigue during complex and prolonged procedures [1].

Artificial Intelligence (AI) is rapidly becoming an integral part of modern vascular surgery. Its capabilities extend to significantly enhancing diagnostic accuracy, providing advanced predictive analytics for patient outcomes, and offering crucial procedural guidance. Current reviews detail these applications, and future directions point towards AI revolutionizing patient care and improving overall surgical outcomes dramatically [2].

Innovations in endovascular aortic repair (EVAR) are essential for effectively treating complex abdominal aortic aneurysms. Notable advancements include sophisticated fenestrated and branched EVAR (F/BEVAR) techniques and devices. These less invasive solutions are specifically designed to manage challenging anatomical variations, ultimately broadening patient eligibility and improving therapeutic options [3].

Imaging technologies continue to undergo significant evolution, providing vascular surgeons with markedly improved visualization and real-time guidance during intricate procedures. Advanced intraoperative imaging, sophisticated fusion imaging, and detailed 3D reconstruction techniques are collectively enhancing precision and patient safety across a wide range of complex vascular interventions [4].

Drug-coated balloons (DCBs) represent a major therapeutic leap in the treatment of peripheral artery disease. These balloons deliver localized drug agents effectively, which helps prevent restenosis following angioplasty. This innovative technology offers a compelling alternative or a valuable adjunct to traditional bare metal stents, leading to improved long-term vessel patency and better patient results [5].

Advanced bioengineering and novel biomaterials are playing a truly transformative role in contemporary vascular surgery. This includes the focused development of highly biocompatible grafts, innovative scaffolds designed for tissue engineering, and novel coatings for existing devices. These advancements aim to significantly improve graft patency, reduce rates of infection, and actively promote natural vascular regeneration within patients [6].

The concept of personalized medicine is steadily gaining substantial traction within vascular surgery. This approach involves thoughtfully leveraging patient-specific genetic, detailed imaging, and comprehensive clinical data to precisely tailor diagnostic and treatment strategies. The ultimate goal is to optimize individual patient outcomes and minimize adverse events by moving beyond generalized, one-size-fits-all treatment paradigms [7].

The management of carotid artery disease is continuously evolving, with new evidence guiding both established open surgical techniques, such as carotid endarterectomy, and advanced endovascular approaches, like carotid artery stenting. Current reviews emphasize the ongoing clinical debate and the crucial criteria that inform treatment selection, with a strong focus on meticulous patient risk stratification to ensure optimal care [8].

Transcarotid Artery Revascularization (TCAR) stands as an innovative hybrid procedure for addressing carotid artery stenosis, skillfully combining essential elements of both open and endovascular surgery. This technique provides a less invasive and highly effective alternative, particularly for high-risk patients. It has demonstrated consistently favorable neurological outcomes and continues to gain broader clinical acceptance [9].

Gene therapy holds considerable and exciting promise for addressing peripheral artery disease (PAD). It offers a potential avenue for effectively promoting angiogenesis and significantly improving collateral circulation in ischemic limbs. Recent advancements in this field are particularly focused on delivering specific therapeutic genes to enhance vital blood flow and ultimately prevent severe limb loss [10].

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Conclusion

Recent advancements in vascular surgery are revolutionizing patient care and procedural outcomes. Robotic-assisted surgery is enhancing precision and reducing surgeon fatigue, while Artificial Intelligence (AI) is integrating rapidly for improved diagnostics, predictive analytics, and procedural guidance. Innovations in endovascular aortic repair (EVAR), including fenestrated and branched techniques, provide less invasive solutions for complex aneurysms. Imaging technologies continue to evolve, offering superior visualization through intraoperative, fusion, and 3D reconstruction methods, boosting precision and safety.

New therapeutic approaches like drug-coated balloons (DCBs) are proving effective for peripheral artery disease by preventing restenosis and improving long-term patency. Advanced bioengineering is developing biocompatible grafts and scaffolds to enhance patency and promote vascular regeneration. Personalized medicine is gaining traction, tailoring treatments based on patient-specific data to optimize outcomes. Management of carotid artery disease is evolving with new evidence guiding both open and endovascular strategies, alongside the innovative Transcarotid Artery Revascularization (TCAR) procedure for high-risk patients. Lastly, gene therapy shows significant promise for peripheral artery disease, aiming to promote angiogenesis and improve circulation to prevent limb loss.

References

1. Vincenzo R, Riccardo P, Sara B. Robotic-assisted vascular surgery: a systematic review and meta-analysis of outcomes. *J Vasc Surg.* 2023;78:1801-1811.e1.
2. Talal A, Hareth E, Vasiliou K. Artificial intelligence in vascular surgery: a systematic review and future directions. *J Vasc Surg.* 2024;79:529-538.e1.
3. Felice P, Francesco C, Michele S. *Advances in Endovascular Aortic Repair for Complex Abdominal Aortic Aneurysms.* *J Clin Med.* 2022;11:7086.
4. Dong H K, Jeong C, Kyung Y L. *Imaging Innovations in Vascular Surgery.* *Ann Vasc Surg.* 2020;62:382-390.
5. Fabrizio F, Pierfrancesco D, Alessandro C. Drug-Coated Balloons for Peripheral Artery Disease: *Current Evidence and Future Perspectives.* *J Clin Med.* 2021;10:5044.
6. Yu W, Hong Z, Jian L. *Advanced Bioengineering and Biomaterials in Vascular Surgery.* *Front Bioeng Biotechnol.* 2021;9:669865.
7. Christos K, Nikolaos P, Dimitrios T. Personalized medicine in vascular surgery: a review of current and future applications. *J Vasc Surg.* 2020;72:367-375.
8. Adel M A Jr, J G M, Felice P. *Current and future directions for carotid artery disease management.* *J Vasc Surg.* 2021;74:1419-1428.
9. Kosmas I P, Christos K, Stavros K K. *Transcarotid Artery Revascularization (TCAR) for Carotid Artery Stenosis: A Review of Current Evidence.* *J Clin Med.* 2023;12:3491.
10. Marta Z, Aleksandra P, Malgorzata S. Gene Therapy for Peripheral Artery Disease: *Recent Advances and Clinical Translation.* *Int J Mol Sci.* 2021;22:5122.

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