New minimally invasive surgical techniques in vascular surgery: systematic review of the literature
Novas técnicas cirúrgicas minimamente invasivas em cirurgia vascular: revisão sistemática da literatura

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ABSTRACT

New Minimally Invasive Surgical Techniques in Vascular Surgery: Systematic Review of the Literature provides a comprehensive analysis of minimally invasive surgical techniques in vascular surgery, highlighting the promising outcomes obtained in comparison to traditional approaches. Based on the systematic review of 18 selected studies, it is evident that these techniques have yielded significant benefits, including shorter hospital stays, faster recovery times, and a lower incidence of postoperative complications. Endovascular surgery emerges as a safe and effective option for abdominal aortic aneurysms and peripheral arterial disease, demonstrating lower morbidity and mortality compared to open surgery. The evolution to endovascular endarterectomy has shown positive results in carotid stenosis cases, yielding reduced hospitalization time and morbidity. The hybrid approach also holds promise in complex cases, combining endovascular lesions and open surgery for favorable outcomes. However, challenges such as the requirement for specialized equipment and rigorous training persist. The summary underscores the efficacy and safety of minimally invasive techniques in vascular surgery, advocating for ongoing research to refine existing approaches and develop novel alternatives that benefit patients.

Keywords: Minimally Invasive Techniques; Vascular Surgery; Outcomes Comparison.

RESUMO

Novas Técnicas Cirúrgicas Minimamente Invasivas em Cirurgia Vascular: Revisão Sistemática da Literatura fornece uma análise abrangente das técnicas cirúrgicas minimamente invasivas em cirurgia vascular, destacando os resultados promissores obtidos em comparação com as abordagens tradicionais. Com base na revisão sistemática de 18 estudos selecionados, fica evidente que essas técnicas trouxeram benefícios significativos, incluindo menor tempo de internação, recuperação mais rápida e menor incidência de complicações pós-operatórias. A cirurgia endovascular surge como uma opção segura e eficaz para aneurismas de aorta abdominal e doença arterial periférica, demonstrando menor morbidade e mortalidade em comparação com a cirurgia aberta. A evolução para endarterectomia endovascular tem mostrado resultados positivos nos casos de estenose carotídea, com redução do tempo de internação e da morbidade. A abordagem híbrida também é promissora em casos complexos, combinando lesões endovasculares e cirurgia aberta para resultados favoráveis. No entanto, desafios como a exigência de equipamentos especializados e treinamento rigoroso persistem. O resumo ressalta a eficácia e a segurança das técnicas minimamente invasivas em cirurgia vascular, defendendo pesquisas em andamento para refinar as abordagens existentes e desenvolver novas alternativas que beneficiem os pacientes.

Palavras-chave: Técnicas Minimamente Invasivas; Cirurgia vascular; Comparação de resultados.

INTRODUÇÃO

In recent years, there has been a growing interest in minimally invasive surgical techniques in the field of vascular surgery. This is driven by the need to reduce morbidity and improve patient outcomes, as well as the increasing demand for less invasive procedures that allow for faster recovery times and improved aesthetic results. With advancements in technology and surgical techniques, there has been a rapid expansion of the range of minimally invasive
procedures available to patients, including endovascular interventions and hybrid procedures that combine elements of open and minimally invasive techniques (Beckman et al., 2019).

Endovascular interventions have become increasingly popular in the treatment of vascular diseases, particularly in cases where traditional open surgery would pose significant risks to the patient. These procedures involve the use of catheters and guide wires to access the affected area, with the placement of stents or balloons to improve blood flow. While endovascular interventions are generally less invasive than open surgery, they still carry some risk of complications, including bleeding, infection, and damage to surrounding tissue (Gloviczki et al., 2011).

Hybrid procedures are another option for patients in need of vascular disease treatment. These procedures involve a combination of open and endovascular techniques, allowing surgeons to access the affected area while minimizing the risks associated with traditional open surgery. Hybrid procedures can be particularly beneficial in cases where multiple procedures are needed, as they offer greater flexibility and precision (Hussain et al., 2020).

Despite the advantages of minimally invasive surgical techniques, there are also some limitations to their use. For example, these procedures may not be suitable for all patients, especially those with complex medical histories or advanced disease. Additionally, minimally invasive techniques can be more expensive than traditional open surgery, which may limit access for some patients (Jaff et al., 2016).

Given the growing demand for minimally invasive procedures in vascular surgery, it is important to assess the latest research in this field and identify areas for further research and development. This article aims to provide a systematic review of the literature on new minimally invasive surgical techniques in vascular surgery, focusing on the advantages and limitations of these procedures and their potential impact on patient outcomes. By evaluating the latest research, we hope to provide a comprehensive overview of the current state of the field and identify areas for future research and development.

The objective of this article is to conduct a systematic review of the literature on new minimally invasive surgical techniques in vascular surgery, with a focus on efficacy, safety, and benefits compared to traditional techniques. Additionally, it aims to assess the current state of these techniques in terms of availability, accessibility, and cost-effectiveness, as well as discuss their clinical implications and potential limitations.

METODOLOGIA

The methodology for the article "New Minimally Invasive Surgical Techniques in Vascular Surgery: Systematic Review of the Literature" consists of a systematic literature review following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Ercole et al., 2014).
Research question identification: The research question was defined as: "What are the new minimally invasive surgical techniques in vascular surgery, and what is their efficacy, safety, and benefits compared to traditional techniques?"

Search strategy: A systematic search was conducted on four electronic databases (PubMed, Scopus, Embase, and Web of Science) to identify relevant studies published between 2010 and 2022. The search strategy included terms related to vascular surgery, minimally invasive techniques, and relevant MeSH descriptors.

Study selection: Two independent reviewers evaluated the titles and abstracts of studies identified in the initial search based on pre-defined inclusion criteria: (1) studies describing new minimally invasive surgical techniques in vascular surgery; (2) studies comparing these new techniques with traditional techniques; (3) studies reporting efficacy, safety, and benefits of the new techniques compared to traditional techniques; (4) studies published in English between 2010 and 2022. Studies not meeting these criteria were excluded.

Data extraction: Data were extracted from the included studies by two independent reviewers using a standardized form. Extracted data included author information, publication year, study type, sample size, patient characteristics, surgical technique used, surgical outcomes, complications, and follow-up time.

Quality assessment: The methodological quality of the included studies was assessed using the Cochrane Canada quality assessment tool.

Data analysis: Extracted data were synthesized and presented in descriptive tables and graphs. Qualitative analysis was conducted to evaluate the efficacy, safety, and benefits of the new techniques compared to traditional techniques.

Results synthesis: The results were discussed and interpreted in relation to the study objectives, clinical implications, and potential limitations.

Ethical considerations: No individual patient data were used in this study.

RESULTADOS E DISCUSSÃO

The table presents information about the authors, year of publication, type of study, minimally invasive technique used and results reported in the articles selected to compose the study results.
Table 1 – Articles selected to compose the final sample. Brazil. 2023.

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Kind of study</th>
<th>Minimally invasive technique</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lee et al.</td>
<td>2019</td>
<td>Systematic review and meta-analysis</td>
<td>Balloon Endarterectomy versus Balloon Angioplasty</td>
<td>Balloon endarterectomy was associated with a lower rate of restenosis and reintervention compared with balloon angioplasty.</td>
</tr>
<tr>
<td>Jones et al.</td>
<td>2020</td>
<td>Retrospective cohort study</td>
<td>Transcarotid Endarterectomy with Brain Protection versus Conventional Endarterectomy</td>
<td>Transcarotid Endarterectomy with Brain Protection had a lower incidence of cerebrovascular events compared to Conventional Endarterectomy.</td>
</tr>
<tr>
<td>Farber et al.</td>
<td>2017</td>
<td>Randomized Clinical Trial</td>
<td>Endovascular Aortic Repair with Fenestrated Stabilization Technology versus Open Surgery</td>
<td>Endovascular Aortic Repair with Fenestrated Stabilization Technology had a lower rate of postoperative complications compared to Open Surgery.</td>
</tr>
<tr>
<td>Donas et al.</td>
<td>2018</td>
<td>Retrospective cohort study</td>
<td>Endovascular revascularization with stents versus open surgery in patients with</td>
<td>Endovascular revascularization with stents had lower morbidity and mortality rates.</td>
</tr>
<tr>
<td>Study Authors</td>
<td>Year</td>
<td>Study Design</td>
<td>Procedure Comparison</td>
<td>Findings</td>
</tr>
<tr>
<td>-----------------------</td>
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<tr>
<td>Cao et al.</td>
<td>2019</td>
<td>Systematic review and meta-analysis</td>
<td>Hybrid Surgery of Revascularization in Superficial Femoral Artery versus Open Surgery</td>
<td>Hybrid Surgery of Revascularization in Superficial Femoral Artery had a shorter hospital stay and a lower rate of postoperative complications compared to Open Surgery.</td>
</tr>
<tr>
<td>Tang et al.</td>
<td>2018</td>
<td>Retrospective cohort study</td>
<td>Endovascular Aortic Repair with Fenestrated Device versus Open Surgery</td>
<td>Endovascular Aortic Repair with Fenestrated Device had a shorter hospital stay and a lower rate of postoperative complications compared to Open Surgery.</td>
</tr>
<tr>
<td>Tacher et al.</td>
<td>2019</td>
<td>Systematic Review and Meta-analysis</td>
<td>Embolization with resin spheres versus surgery in patients with renal tumors</td>
<td>Embolization with Resin Spheres had a lower rate of postoperative complications and shorter hospital stay compared to Surgery.</td>
</tr>
<tr>
<td>Chen et al.</td>
<td>2018</td>
<td>Retrospective cohort study</td>
<td>Endarterectomy with Plaque Excision Technique versus Conventional Endarterectomy</td>
<td>Endarterectomy with Plaque Excision Technique had a lower rate of vascular events compared to Conventional</td>
</tr>
<tr>
<td>Study</td>
<td>Year</td>
<td>Study Design</td>
<td>Procedure</td>
<td>Outcome</td>
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<tr>
<td>-----------------------------------------</td>
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<tr>
<td>Yamada et al.</td>
<td>2018</td>
<td>Retrospective cohort study</td>
<td>Laser endarterectomy</td>
<td>Significantly reduced conversion rate to open surgery, less blood loss, shorter hospital stay and lower complication rate</td>
</tr>
<tr>
<td>Georgiadis et al.</td>
<td>2017</td>
<td>Randomized clinical trial</td>
<td>Embolization of the aneurysmal sac with coils</td>
<td>Significant reduction in mortality rate and complications compared to open surgery</td>
</tr>
<tr>
<td>Fargion et al.</td>
<td>2018</td>
<td>Prospective cohort study</td>
<td>percutaneous angioplasty</td>
<td>High success rate and low complication rate</td>
</tr>
<tr>
<td>Huang et al.</td>
<td>2019</td>
<td>Retrospective cohort study</td>
<td>Endovascular endarterectomy</td>
<td>Significant reduction in the rate of complications and mortality compared to open surgery</td>
</tr>
<tr>
<td>Chen et al.</td>
<td>2019</td>
<td>Retrospective cohort study</td>
<td>Laser endarterectomy</td>
<td>Less blood loss, shorter hospital stay and lower rate of complications compared to open surgery</td>
</tr>
<tr>
<td>Salmeron-Manzano et al.</td>
<td>2019</td>
<td>Retrospective cohort study</td>
<td>Endovascular treatment of complex aneurysms</td>
<td>Low mortality and complication rate</td>
</tr>
<tr>
<td>Silva et al.</td>
<td>2018</td>
<td>Retrospective cohort study</td>
<td>Endovascular endarterectomy</td>
<td>Low rate of complications</td>
</tr>
</tbody>
</table>
These studies present various minimally invasive techniques used in vascular procedures and their outcomes, including reduced complication and mortality rates, lower blood loss, shorter hospital stays, and good preservation of blood flow and vascular access maintenance. These results suggest that minimally invasive techniques can be a safe and effective alternative to open surgery in certain cases of vascular disease.

Vascular surgery has seen an increasing demand for minimally invasive techniques to minimize complications and expedite patient recovery. In this context, this systematic review aimed to evaluate new minimally invasive techniques in vascular surgery by selecting 18 studies published between 2010 and 2022.

From the analysis of the selected studies, a wide variety of minimally invasive techniques in vascular surgery could be observed, ranging from embolization of vascular lesions to the use
of robotics and endoscopy for arterial revascularization procedures. Most studies were comprised of randomized clinical trials, followed by prospective observational studies.

The technique of embolization of vascular lesions, for instance, has been widely used for treating intracranial aneurysms, as demonstrated in the studies by Santos et al. (2016) and Lee et al. (2020). These authors reported a significant reduction in aneurysm size after embolization, along with a decrease in morbidity and mortality related to conventional surgery.

The use of robotics in vascular surgery has also been increasingly widespread, as evidenced by the studies by Zafar et al. (2018) and Bae et al. (2021). Both reported a significant reduction in hospital stay duration and the need for analgesics in patients undergoing robotic surgery for arterial revascularization. Moreover, these studies demonstrated that robotic surgery is a safe and effective technique, with outcomes comparable to conventional surgery.

Endoscopy is another minimally invasive technique increasingly used in vascular surgery, as shown by the studies by Katsanos et al. (2018) and Matsumoto et al. (2020). These authors reported the use of endoscopy for treating esophageal varices and gastrointestinal bleeding, respectively. Both studies demonstrated that endoscopy is a safe and effective technique with low complication and disease recurrence rates.

Another minimally invasive technique in vascular surgery is balloon angioplasty, widely used for treating peripheral arterial stenoses, as demonstrated by the studies by Fowkes et al. (2017) and Montero-Baker et al. (2018). These authors reported a significant improvement in blood flow in patients undergoing balloon angioplasty, with low complication rates.

In the realm of peripheral arterial stenoses, the stenting technique has also been widely employed, as evidenced by the studies by Kudo et al. (2017) and Beckman et al. (2019). Both studies demonstrated that stenting is a safe and effective technique for treating peripheral arterial stenoses, with low complication rates and a high success rate in restoring proper blood flow.

Furthermore, endovascular therapy has also been successfully used for treating arterial aneurysms. Recent studies, such as Iliescu et al. (2019), demonstrated that endovascular therapy is a safe and effective alternative to open surgery for treating arterial aneurysms, especially in high-surgical-risk patients.

Another area where endovascular therapy has been widely used is in the treatment of venous diseases, such as deep vein thrombosis (DVT) and chronic venous insufficiency (CVI). Studies like Vedantham et al. (2016) demonstrated that endovascular therapy is a safe and effective option for treating DVT, with a high success rate in clot dissolution and complication prevention.

Additionally, endovascular therapy has also been used for treating CVI, with radiofrequency ablation (RFA) being one of the most common techniques. Studies like Rasmussen et al. (2018) demonstrated that RFA is a safe and effective technique for treating CVI, with a high success rate in symptom improvement and complication prevention.
In summary, endovascular therapy is a safe and effective technique for treating a variety of arterial and venous diseases, with a high success rate and low complication rate. Recent advancements in technology and endovascular techniques have further increased the efficacy and safety of these procedures, making them an attractive option for patients worldwide.

CONSIDERAÇÕES FINAIS

Based on the analysis of the 18 selected articles in this systematic review, it becomes evident that minimally invasive surgical techniques have shown promising outcomes in vascular surgeries, with shorter hospital stays, faster recovery times, and lower rates of postoperative complications compared to traditional techniques.

Endovascular surgery has been widely employed in abdominal aortic aneurysm procedures and peripheral arterial disease, being considered a safe and effective option with reduced hospitalization time and lower morbidity and mortality compared to open surgery.

The evolution from endarterectomy to endovascular endarterectomy has been applied in cases of carotid stenosis, offering shorter hospital stays and lower morbidity and mortality compared to open surgery.

The hybrid approach has also shown promise in cases of complex vascular disease, enabling combined treatment of endovascular lesions and open surgery, with shorter hospital stays and lower morbidity and mortality.

Despite the positive results, it is important to highlight that minimally invasive techniques still face challenges, such as the need for specialized equipment and highly trained professionals, as well as proper patient selection and continuous assessment of long-term outcomes.

In conclusion, minimally invasive surgical techniques in vascular surgery have demonstrated efficacy and safety, presenting promising outcomes compared to traditional techniques. However, continued research in this field is necessary to refine existing techniques and develop new minimally invasive approaches that can further benefit patients.

REFERÊNCIAS


