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INTERVENTIONS IN THE TREATMENT OF GRADE IV AND V SPLENIC LESIONS IN BLUNT ABDOMINAL TRAUMA: ANGIOEMBOLIZATION OR SPLENECTOMY

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ABSTRACT

Introduction: The spleen is the organ most affected in blunt abdominal trauma and performs important immunological activities. Objective: To synthesize the most current approaches for the treatment of severe splenic lesions in blunt abdominal trauma, addressing conservative and surgical treatments, in addition to highlighting the need for each of the approaches, and comparing their respective complications. Methodology: This integrative review was carried out in the PubMed, SciELO, and VHL databases, searching for articles published between 2019 and 2024. The DeCS/MeSH and Rayyan tools were used to collaborate in the creation and organization of the research. The selection of articles was carried out in a double-blind manner, of which they were systematic reviews, observational studies, literature reviews, and randomized studies. Results: Initially, 371 articles were found in the three databases used. After removing 145 duplicates and 41 studies that met the exclusion criteria, 185 articles remained for double-blind evaluation. After reading the title, abstract, and introduction, 120 articles were excluded. In total, 65 articles were read in full, of which 51 were excluded due to lack of relevance to the research. In the end, 14 articles were selected, including systematic reviews, observational studies, literature reviews, and randomized studies. Conclusion: Conservative management preserves the immune function of the spleen, in addition to reducing other complications. Although splenectomy is currently preferable over angioembolization of the splenic artery in severe cases, there are indications that show the possibility of conservative management in high-grade lesions.

Keywords: Spleen. Splenectomy. Splenic Artery.

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INTRODUCTION

The spleen is the most injured organ in blunt abdominal trauma due to its anatomical location and its vast capsular vascularization. However, it is an organ that plays an important role in immune defense, such as protecting against bacterial infections, filtration, blood storage, and phagocytosis. Thus, methods for splenic conservation began to gain space for the choice of treatment. In the past, splenectomy was the only available treatment of splenic lesions, but since the 1980s, angioembolization has been established as the standard of care for hemodynamically stable patients. (FOMIN et al., 2019; KLEINSORGE et al., 2021; MATSUMOTO et al., 2023; YILDIZ et al., 2022)

The percentage of patients admitted with severe splenic trauma, hemodynamically unstable, ranges from 10% to 20% of cases. (ARVIEUX et al., 2020)

The management of splenic trauma involves splenectomy and conservative management, i.e., angioembolization of the splenic artery, the latter aims to increase the preservation rates of the affected organ. (SCHNEIDER et al., 2021) The choice of angioembolization of the splenic artery or surgical management, splenectomy, is directly correlated with the degree of the splenic lesion and with the hemodynamic criteria presented by the patient.(ACOSTA-BRUNAGA, 2023; OSMAN et al., 2023) Currently, it is defined that the treatment of choice for splenic lesions that have hemodynamic stability and adequate infrastructure in the health service should be splenic artery embolization. (MEIRA JÚNIOR et al., 2021)

However, in hemodynamically unstable patients, splenectomy is still the definitive treatment of choice, given the need to stop hemorrhage and preserve the patient's life. (SCHNEIDER et al., 2021)

The choice between the appropriate procedures to be performed in patients should be made after hemodynamic evaluation, classification of the splenic lesion according to images provided by Computed Tomography (CT) and evaluation of active bleeding. (SCHNEIDER et al., 2021; SERNA et al., 2021)

METHODOLOGY

To carry out this integrative review, the following steps were followed: definition of the hypothesis and objectives of the review; establishment of the inclusion and exclusion criteria of the articles (sample selection); identification of the information to be extracted from the selected articles; analysis of the results; discussion and presentation of the findings; and, finally, the presentation of the review. In order to guide the review, the following question was formulated: What is the ideal approach for patients with severe

splenic lesions (grades IV and V) resulting from blunt abdominal trauma? Is it possible to treat hemodynamically unstable patients with conservative management?

This integrative review was carried out based on bibliographies from digital libraries such as PubMed, SciELO and LILACS.

Keywords were used: blunt abdominal trauma, splenic trauma, spleen, bleeding, hemorrhagic shock, embolization, splenic artery and splenectomy with their different variations and combinations, in Portuguese and English using the Boolean operators "AND" in PubMed and SciELO and "E" in the VHL. As an inclusion criterion, materials published between the years 2019 and 2024 were used, and as an exclusion criterion, pediatric and animal studies, or studies that dealt with non-traumatic splenic rupture, were used.

The Health Sciences Descriptors (DeCS) tool and the Medical Subject Headings (MeSH) descriptors were used to assist in the translation of the scientific terms, "blunt trauma", "abdominal", "spleen", "hemorrhage", "Shock, hemorrhagic", "splenic artery", "embolization" and "splenectomy". In addition, the Rayyan tool was used in order to organize the articles that would be used as a basis for this integrative review study. The selection of articles was made in double-blind, and the title, abstract and full text were read, after the application of the filters, individually by the authors of this study. Studies that were undefined as to inclusion in the article by the authors were decided by the advisor. The PRISMA (Preferred Reporting Items for Systematic review and Meta-Analyses) review methodology was used, but adapted because it is an integrative review.

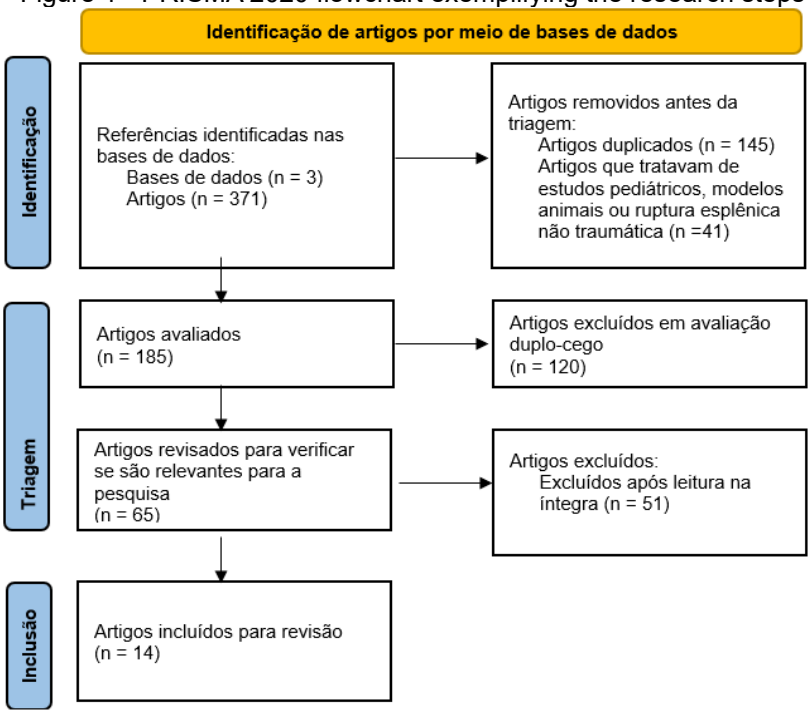
Regarding the articles approved in this reading criterion, their information was extracted and inserted in a table (supplementary table, cf. Appendices). The objective was to classify and organize the data of each study for the elaboration of the results, discussion and conclusions of this work. The table includes the following topics analyzed in each article: database; title of the article; Authors; year of publication; methodology; Conclusions.

RESULTS

A total of 371 articles were found, adding the 3 databases used (PubMed, SciELO and VHL), of which 145 were duplicates and 41 were studies that contained the exclusion criteria, so they were excluded. There were 185 articles evaluated in double-blind, and after reading the title, abstract, and introduction, 120 were excluded from the research because they did not meet the proposed objectives. In the end, 65 articles were read in full and 51 were excluded because they were not relevant to the present study. In the end, 14 were selected in the following types: systematic review articles, observational studies, literature

review and randomized study. An adapted PRISMA 2020 flowchart outlining this study was carried out (Fig. 1), characterizing the review steps.

Figure 1 - PRISMA 2020 flowchart exemplifying the research steps

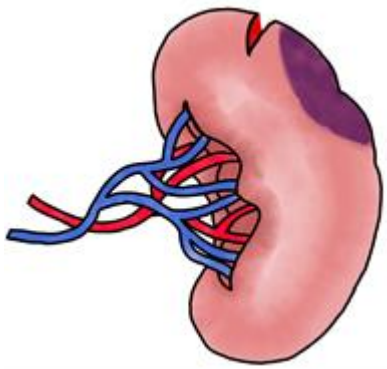


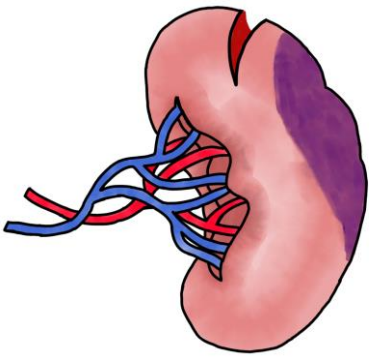
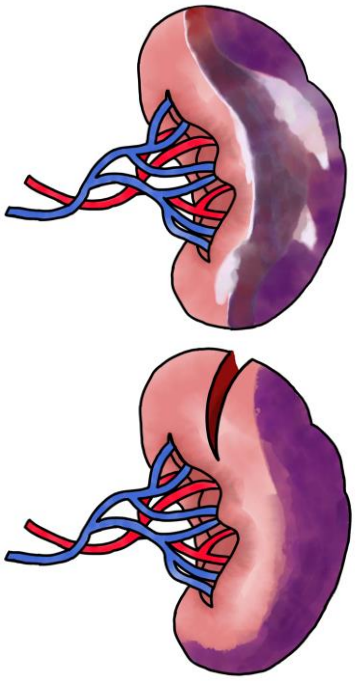
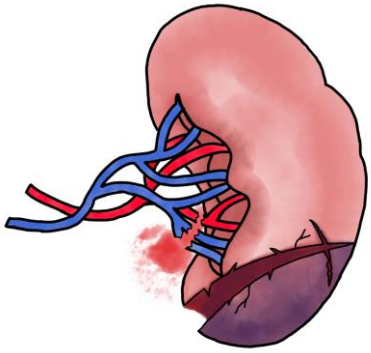
Source: Adapted from HADDAWAY et al., 2022.

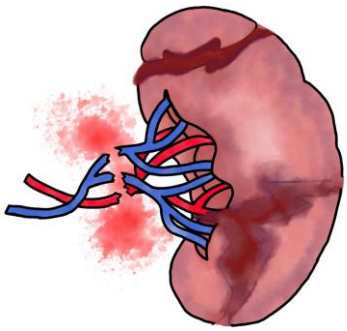
DISCUSSION

Splenic lesions are classified according to the *Organ Injury Scale of the American Association for the Surgery of Trauma* (AAST) identified by computed tomography (Table 1). In addition to demonstrating the severity of the lesion, CT is an important means to reveal additional lesions that can define and change the therapeutic approach. (MEIRA JÚNIOR et al., 2021; PATIL; GOODIN; FINDEISS, 2020; WIIK LARSEN; THORSEN; SØREIDE, 2023)

Table 1 - Splenic lesion scale.

I		• HEMATOMA: Subcapsular <10% of surface area • LACERATION: Parenchymal <1cm deep

II		• HEMATOMA: Subcapsular of 10% to 50% of the surface area; • HEMATOMA: Intraparenchymal <5 cm • LACERATION: Parenchymal 1 - 3 cm
III		• HEMATOMA: Subcapsular >50% of surface area • RUPTURE: Subcapsular/intraparenchymal ≥ 5 cm • LACERATION: Parenchymal >3cm deep • HEMATOMA: Subcapsular >50% of surface area
IV		• LACERATION: Parenchymal involving segmental or hilar vessels that produce devascularization > 25% of the spleen • VASCULAR: Any injury in the presence of vascular injury or active bleeding confined to the splenic capsule

V		• VASCULAR: Any injury in the presence of vascular injury or active bleeding that goes beyond the splenic capsule to the peritoneum • LACERATION: Spleen Fully Shattered

Source: Adapted from AAST (2024).

High-grade AAST lesions (grades IV and V) are usually treated with splenic artery embolization or splenectomy, depending on the patient's hemodynamic status. (PATIL; GOODIN; FINDEISS, 2020)

Currently, the use of angioembolization of the splenic artery is more widely adopted than splenectomy, in order to preserve the immune function of the spleen and avoid the immunosuppression found in splenectomized patients, who may suffer from infections by encapsulated germs and may lead to a fatal outcome. (ACOSTA-BRUNAGA, 2023; FOMIN et al., 2019; MEIRA JÚNIOR et al., 2021) The viability of splenic tissue is preserved because MNO reduces the perfusion pressure of the spleen, promoting the adaptation of the circulation to a collateral circulation. (WIIK LARSEN; THORSEN; SØREIDE, 2023) In addition, conservative management has shown better morbidity and mortality rates, shorter hospital stays, and complications related to high-grade lesions, in addition to less need for blood transfusion, reduced costs, and the absence of invasive surgeries. (CIOFFI; CIMBANASSI; CHIARA, 2023; MEIRA JÚNIOR et al., 2021)

In recent years, there has been a significant increase in the choice of angioembolization of the splenic artery in relation to the surgical approach, which has decreased in the number of choice for the treatment of high-grade splenic lesions (IV and V), which, as a result of the AAST-OIS 2018 classification, has become more recognizable and, therefore, has had its number of cases increased. (LIN et al., 2023)

However, when conservative management fails, splenectomy is the treatment of choice, as well as in cases where there is hemodynamic instability in patients. (ACOSTA-BRUNAGA, 2023; WIIK LARSEN; THORSEN; SØREIDE, 2023) And studies have even shown that patients with worse vital sign parameters and an early need for blood transfusion were more likely to have failure in conservative management, and thus progressed to a splenectomy. However, even those who have better clinical criteria can evolve with failure.(CIOFFI; CIMBANASSI; CHIARA, 2023; MEIRA JÚNIOR et al., 2021)

Although angioembolization of the splenic artery is currently the gold standard treatment, it is still limited to hemodynamically stable patients. However, a recent meta-analysis studied the possibility of extending this practice to hemodynamically unstable patients, which demonstrated high success rates in splenic lesions in patients who had a good response to fluid resuscitation and who had early access to radiological services, which were able to diagnose their lesion. (CIOFFI; CIMBANASSI; CHIARA, 2023)

As with any procedure, there are risks of complications, even in conservative management. Thus, some can be mentioned as late rupture of the subcapsular hematoma or pseudoaneurysm, infections, infarction, splenic abscesses and contrast-induced nephropathy, fever and ipsilateral pleural effusion. These complications are highly significant and of clinical importance, which should be taken into account. Thus, it is essential that there is correct daily clinical monitoring of the patient after embolization. (ACOSTA-BRUNAGA, 2023; CIOFFI; CIMBANASSI; CHIARA, 2023; FOMIN et al., 2019)

It has been demonstrated that the failure of conservative management is less than 10%, and can reach 75% in those patients with grade V splenic lesions, whose evolution is associated with splenectomy or even death. (MEIRA JÚNIOR et al., 2021)

In those patients who are hemodynamically unstable, or who have continued persistent bleeding after angioembolization of the splenic artery, splenectomy should be performed as a definitive measure in order to preserve the patient's life. In these cases, it is important to observe possible complications, such as fulminant infections by encapsulated germs, due to immunosuppression in patients without the spleen. Thus, to avoid this event, prophylactic vaccination is recommended two weeks after the surgical procedure against pneumococcus, *Haemophilus influenzae* type B, and meningococcus, in addition to annual vaccination against the influenza virus. (MEIRA JÚNIOR et al., 2021; SERNA et al., 2021; WIIK LARSEN; THORSEN; SØREIDE, 2023)

A recent meta-analysis demonstrated that angioembolization of the splenic artery is not related to a drop in immunity, so there is no evidence for routine prophylactic vaccination in patients who have undergone this procedure. (MEIRA JÚNIOR et al., 2021; PATIL; GOODIN; FINDEISS, 2020)

FINAL CONSIDERATIONS

The management of splenic trauma has evolved significantly in recent decades, reflecting a paradigmatic shift toward preserving splenic function and minimizing complications associated with splenectomy. Angioembolization of the splenic artery has emerged as an effective and safe alternative, especially for hemodynamically stable

patients, allowing not only the conservation of the spleen, but also the maintenance of immunity and reduction of morbidity and mortality rates.

The data discussed in this article highlight the importance of a careful evaluation of the patient's hemodynamic status and the classification of splenic lesions to determine the most appropriate therapeutic approach. Although splenectomy is still the treatment of choice in cases of hemodynamic instability or failure of conservative management, there are indications that splenic angioembolization can be used in patients with lesions IV and V, who have a favorable response to volume replacement and early diagnosis of the lesion.

In addition, the long-term implications of spleen removal, such as susceptibility to infections from encapsulated germs, reinforce the need for close follow-up and prevention strategies, such as vaccination, even if angioembolization does not show a significant drop in immunity.

In summary, the choice of treatment should be individualized, considering the characteristics of each patient and the severity of the splenic lesion. Continued research and implementation of evidence-based protocols are essential to improve the care of patients with splenic trauma and ensure better outcomes.

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APPENDAGES

Appendix A - Supplementary Table. Data extraction table

Base de dados	Ttulo do artigo	Autores	Ano de publicação	Método adotado	Conclusões
BVS	Manejo de traumatismo esplénico en el Hospital Nacional de Itauguá	Acosta-Brunaga et al.	2023	Estudo observacional	O manejo do trauma esplênico mudou ao longo do tempo. Atualmente, busca-se um tratamento não cirúrgico, embora isso dependa das condições do paciente.
PubMed	Effect of Prophylactic Embolization on Patients With Blunt Trauma at High Risk of Splenectomy: A Randomized Clinical Trial	Arvieux et al.	2020	Estudo randomizado	Entre os pacientes com trauma esplênico e alto risco de ruptura, a taxa de preservação do baço em 1 mês não foi estatisticamente diferente entre aqueles que fizeram embolização arterial esplênica profilática (EAE) e os que foram observados e realizaram a embolização se necessário. Dado o alto número de pacientes no grupo da obsevação que precisaram de EAE, ambas as estratégias parecem defendíveis.
PubMed	Blunt abdominal trauma: watch and wait	Cioffi et al.	2023	Revisão	O tratamento não operatório de trauma abdominal fechado representa um avanço na cirurgia de emergência das últimas décadas. Sua aplicação de abordagens angiográficas não cirúrgicas levam a melhores resultados.
PubMed	Traumatic spleen rupture diagnosed during postmortem dissection: A STROBE-compliant restropective study	Fomin et al.	2019	Estudo observacional	O principal risco do tratamento não operatório é a hemorragia tardia repentina, que pode ser fatal antes da cirurgia. Pacientes hemodinamicamente instáveis, devido à intensa hemorragia, geralmente precisam de esplenectomia.
BVS	Impacto da introdução da angioembolização para o tratamento não operatório do trauma esplênico contuso grau III e IV no Hospital João XXIII, Belo Horizonte / Brasil	Kleinsorge et al.	2021	Estudo observacional	A abordagem não cirúrgica do trauma contuso do baço, combinada com angioembolização, mostrou uma redução estatisticamente significativa na necessidade de esplenectomia em lesões esplênicas de graus III e IV.
PubMed	Splenic artery embolization changes the management of blunt splenic injury: an observational analysis of 680 patients graded by the revised 2018 AAST-OIS	Lin et al.	2023	Estudo observacional	A revisão realizada comprova a superioridade da classificação de lesão esplênica AAST-OIS de 2018 em relação à antiga, e apoiam o papel da embolização da artéria esplênica em alterar a tendência do manejo das lesões esplênicas traumáticas.
PubMed	A clinical prediction model for non-operative management failure in patients with high-grade blunt splenic injury	Matsumoto et al.	2023	Estudo observacional	O escore preditivo clínico mostrou uma boa capacidade de prever a falha do tratamento não cirúrgico e pode auxiliar os cirurgiões a tomar decisões mais assertivas no tratamento de lesões esplênicas traumáticas.
SciELO	Tratamento não operatório do trauma esplênico: evolução, resultados e controvérsias	Meira Júnior et al.	2021	Revisão	O TNO de lesões esplênicas é indicado para pacientes estáveis, desde que haja recursos e sem outras lesões associadas que demandam procedimento cirúrgico. Fatores de risco devem ser monitorados, e a conduta precisa ser individualizada, pois não há consenso sobre os protocolos.

PubMed	Conservative Management of Splenic Injury in Blunt Abdominal Trauma: A Single Center Experience	Osman et al.	2023	Estudo observacional	O manejo conservador é seguro e eficaz na maioria dos pacientes com lesão esplênica. Entretanto, a estabilidade hemodinâmica é imprencidível para um desfecho bem-sucedido, por isso, o manejo conservador não é recomendado em pacientes hemodinamicamente instáveis.
PubMed	Update: Splenic Artery Embolization in Blunt Abdominal Trauma	Patil et al.	2020	Revisão	A angioembolização é a abordagem preferencial para o tratamento de lesões esplênicas em trauma abdominal fechado. A escolha do tipo de embolização depende da gravidade da lesão e da condição geral do paciente. O objetivo é controlar o sangramento e preservar a função do baço sempre que possível.
PubMed	Splenic preservation after isolated splenic blunt trauma: The angioembolization paradox	Schneider et al.	2021	Estudo observacional	A angioembolização tem sido cada vez mais utilizada em casos de trauma esplênico, mas os resultados deste estudo sugerem que esse procedimento pode estar sendo utilizado de forma excessiva, sem evidências suficientes para justificar sua superioridade em relação à esplenectomia.
PubMed	Damage control surgery for splenic trauma: "preserve na organ - preserve a life"	Serna et al.	2021	Revisão	Em casos de trauma grave com lesão esplênica, a melhor abordagem ainda é debatida. A combinação de técnicas de ressuscitação rápida e cirurgia de controle de danos com procedimentos minimamente invasivos pode salvar o baço. Porém, se o sangramento não parar, a esplenectomia pode ser necessária para salvar a vida do paciente
PubMed	Splenic injury from blunt trauma	Wiik Larsen et al.	2023	Revisão	A angioembolização tem se mostrado uma alternativa promissora à esplenectomia para lesões esplênicas causadas por trauma, permitindo, em muitos casos, preservar o órgão. No entanto, a eficácia desse procedimento pode variar dependendo das condições do paciente. Porém, a esplnectomia continua sendo a alternativa mais assertiva quando o risco de complicações é alto ou há falha de outros tratamentos.
PubMed	Blunt splenic trauma: Analysis of predictors and risk factors affecting the non-operative management failure rate	Yildiz et al.	2022	Estudo observacional	A angioembolização foi eficaz para pacientes com trauma esplênico grau I a III. Enquanto que para pacientes com lesões mais graves (grau IV), mais da metade foi tratada com sucesso usando a embolização arterial. A identificação de preditores e fatores de risco pode aumentar ainda mais o sucesso do manejo não operatório.