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An Overview on Management of Blunt Splenic Injury

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Abstract:

Background: Blunt splenic injury is one of the most common consequences of abdominal trauma, particularly following road traffic collisions, falls from height, and direct blows to the left upper quadrant. The spleen's friable parenchyma and rich vascular supply make it highly vulnerable to laceration and hemorrhage. In recent decades, advances in imaging, hemodynamic monitoring, and interventional radiology have led to a major shift from routine operative management to selective non-operative strategies. Early recognition, rapid risk stratification, and appropriate therapeutic decisions are critical to reducing morbidity and mortality. Despite significant progress, the optimal management approach continues to depend on patient stability, injury grade, and associated trauma, requiring coordinated multidisciplinary care.

Keywords: Blunt splenic injury; abdominal trauma; non-operative management; splenectomy; splenic artery embolization; hemodynamic instability; trauma surgery.

Introduction:

The spleen plays a central role in hematologic function, immune regulation, and filtration of abnormal blood cells, making its preservation highly desirable whenever safely possible. Blunt splenic injury (BSI) represents the most frequently injured solid organ in blunt abdominal trauma and is associated with significant risk of internal haemorrhage **(1).** Traditionally, splenectomy was considered the standard life-saving procedure for all patients with suspected splenic injury; however, growing recognition of post-splenectomy infectious complications and the development of advanced imaging modalities have transformed modern management practices **(2).**

Computed tomography (CT) with intravenous contrast is now the diagnostic modality of choice, allowing precise grading of splenic injuries and identification of active contrast extravasation, pseudoaneurysms, and vascular blushes. These radiological findings, combined with hemodynamic assessment, guide the decision between non-operative management (NOM), angiographic embolisation, or surgical intervention **(2).** NOM has become the preferred approach in haemodynamically stable patients, offering excellent splenic salvage rates when combined with close monitoring and selective use of angiographic embolisation **(3).**

Nonetheless, operative management—either splenectomy or splenic repair—remains crucial in patients with persistent hemodynamic instability, high-grade injury with ongoing bleeding, or associated intra-abdominal injuries requiring laparotomy. Current evidence emphasises the importance of individualised decision-making, multidisciplinary collaboration between trauma surgeons, interventional radiologists, and critical-care teams, and early identification of patients at risk of NOM failure **(4).**

Blunt splenic injury is managed with conservative treatments, SAE, or surgery, depending on the patient's hemodynamic status, the grade of splenic injury, and the presence of other injuries and/or medical comorbidities. The management approach used may differ among individual institutions depending on the availability of resources **(5)**.

In hemodynamically unstable trauma patients with a positive Focused Assessment with Sonography in Trauma scan, emergent abdominal exploration is performed to identify the cause of intra-abdominal bleeding. If the cause of bleeding is identified as splenic injury, splenectomy is performed as a hemostatic procedure **(6)**.

In recent years, hybrid ER systems, in which the interventional radiological-CT system is installed in the trauma resuscitation room, have become popular in Japan. The access time to CT and SAE can be significantly shortened in the hybrid ER than in the conventional ER, which is expected to expand the indications for CT and SAE for patients with unstable hemodynamic status**(7).**

Hemodynamically stable patients are indicated for NOM. NOM for splenic injury includes observation and SAE, which is selected according to contrast CT findings. Safe follow-up is possible in hemodynamically stable patients with a low-grade (AAST grade I to III) spleen injury without other intra-abdominal injuries, extravasation, pseudoaneurysm, or vessel disruption on contrast-enhanced CT findings **(8)**.

Extravasation of contrast media represents ongoing bleeding. If the CT results indicate extravasation, pseudoaneurysm, or vessel disruption, SAE is required. Prophylactic SAE should also be considered in hemodynamically stable patients with high-grade injuries, regardless of the presence or absence of extravasation, pseudoaneurysm, or vessel disruption **(9)**.

Laparotomy is the gold standard in the management of a penetrating injury of the abdomen. Patients with stable circulation, without peritoneal irritation symptoms, and without findings of suspected intestinal injury on CT are candidates for attempting NOM. However, the higher the grade of injury, the higher the risk of NOM failure **(8)**.

Operative management:

Operative management (OM) has been regarded as the first-line procedure in hemodynamically unstable patients and/or those who have associated injuries requiring surgical exploration, such as peritonitis, bowel evisceration, or impalement. At facilities in which intensive monitoring cannot be performed or SAE is not rapidly available, OM is performed for moderate and severe injuries in hemodynamically stable patients **(10)**.

A splenectomy is chosen when there is injury to the splenic hilum or when the form of splenic injury is so complex and deep that splenic salvage is deemed impossible. A splenectomy should also be considered when the source of bleeding seems to be other than the spleen or when the patient has the triad of traumatic death (hypothermia, acidosis, and coagulopathy) **(11)**.

If the patient's hemodynamic status is stable, bleeding from other organ injuries is controlled, and splenic injury is limited to the upper and lower poles, a partial splenectomy is the treatment of choice. Splenorrhaphy is also selected when the patient is hemodynamically stable or when bleeding is controlled for other organ injuries **(11)**.

In recent years, treatment with NOM has been increasingly used for splenic injury, and surgical treatment has been performed less frequently; however, when NOM fails, a splenectomy is the preferred treatment **(12)**.

Laparoscopic splenectomy is a treatment option that could potentially be performed in patients with stable circulation. However, only a few cases of laparoscopic splenectomy for low-moderate splenic injury have been reported **(13)**.

The overall hospital mortality rate for splenectomy in trauma has been reported to be nearly 2%; regarding complications, the incidence of postoperative bleeding after splenectomy ranges from 1.6% to 3%. It is often difficult to obtain hemostasis of bleeding from the splenic repair area spontaneously, and SAE or revision surgery would be required in such cases. Other complications include abscesses, pancreatic fistulas, thrombosis, and overwhelming post-splenectomy infection (OPSI) **(14)**.

Non-operative management:

NOM is considered the gold standard for the treatment of patients with blunt splenic trauma who are hemodynamically stable after initial resuscitation and who do not have peritonitis or associated injuries requiring

a laparotomy. In trauma centers, the success rate of NOM is close to 90%. The benefits of NOM over OM include reduced hospital costs, the avoidance of non-therapeutic laparotomy, a reduced incidence of intra-abdominal complications and transfusions, reduced mortality, the preservation of immune function, and the prevention of OPSI **(15)**.

Relative contraindications for NOM include a high-grade splenic injury (>grade III), advanced patient age, portal hypertension, traumatic brain injury, and refusal of blood transfusion **(16)**.

The risk of NOM failure is higher in patients with liver cirrhosis. In a review of the US National Trauma Data Bank, patients with cirrhosis had higher rates of complications, NOM failure, and mortality than those without cirrhosis. The causes of liver cirrhosis-associated NOM failure include splenomegaly from portal hypertension-induced venous engorgement, thrombocytopenia (which has been shown to promote bleeding), coagulopathy, and malnutrition (hypoalbuminemia) **(17)**.

SAE:

SAE is generally indicated for hemodynamically stable patients or those with evidence of hemorrhagic shock who are hemodynamically stable with appropriate transfusion and who have a moderate- to high-grade injury and CT findings of vascular injury (extravasation, pseudoaneurysm, vessel disruption, or arteriovenous fistula). SAE should also be considered in all hemodynamically stable patients with a high-grade injury, regardless of the presence of contrast blush on CT **(18)**.

Embolization methods:

SAE for splenic injuries includes proximal and distal embolization. It is believed that distal embolization should be used for focal vascular injuries and proximal embolization for multiple focal injuries **(19)**.

In distal embolization methods, a microcatheter is inserted into the injured artery, and embolization is performed selectively. Embolic materials include gelatin sponges, metallic coils, and n-butyl-2-cyanoacrylate (NBCA). Gelatin sponges are usually used; microcoils are used when there is an A-V fistula. When coagulopathy is present, the use of microcoils or NBCA should be considered. When multiple branches are damaged and there is no time to insert a microcatheter selectively, embolization that includes two or three branches may be considered in order to hasten the process **(19)**.

Proximal embolization of the main trunk of the splenic artery using coils or vascular plugs has been used to reduce blood flow to the spleen and obtain hemostasis. In cases of proximal embolization, blood flow from the right gastroduodenal artery and the short gastric artery in the splenic hilum allows hemostasis without infarction of the spleen. However, caution should be exercised due to the possibility of persistent bleeding from the short gastric artery or right gastroduodenal artery. Therefore, combined embolization, in which distal embolization is performed in addition to proximal embolization, may be preferable **(11)**.

References:

1. Suzuki, T., Shiraishi, A., & Ito, K., et al. (2024). Comparative effectiveness of angioembolization versus open surgery in patients with blunt splenic injury. Scientific Reports, 14, 8800. https://doi.org/10.1038/s41598-024-59420-w
2. Roh, S. (2024). Splenic artery embolization for trauma: a narrative review. Journal of Trauma and Injury, (doi:10.20408/jti.2024.0056).
3. Jones, B. (2024). Splenic artery embolisation for blunt splenic trauma: 10 years of practice at a trauma centre. *Annals of the Royal College of Surgeons of England*, 106, 283-287.
4. Queensland Health. (2024, November 14). *Clinical practice guideline – Blunt splenic injury (adult)*. Queensland Government.
5. Hildebrand, D. R., Ben-Sassi, A., Ross, N. P., Macvicar, R., Frizelle, F. A., & Watson, A. J. M. (2014). Modern management of splenic trauma. Bmj, 348.

6. Wahl, W. L., Ahrns, K. S., Chen, S., Hemmila, M. R., Rowe, S. A., & Arbabi, S. (2004). Blunt splenic injury: operation versus angiographic embolization. Surgery, 136(4), 891–899.
7. Kinoshita, T., Yamakawa, K., Matsuda, H., Yoshikawa, Y., Wada, D., Hamasaki, T., Ono, K., Nakamori, Y., & Fujimi, S. (2019). The survival benefit of a novel trauma workflow that includes immediate whole-body computed tomography, surgery, and interventional radiology, all in one trauma resuscitation room: a retrospective historical control study. Annals of Surgery, 269(2), 370–376.
8. Berg, R. J., Inaba, K., Okoye, O., Pasley, J., Teixeira, P. G., Esparza, M., & Demetriades, D. (2014). The contemporary management of penetrating splenic injury. Injury, 45(9), 1394–1400.
9. Skattum, J., Naess, P. A., Eken, T., & Gaarder, C. (2013). Refining the role of splenic angiographic embolization in high-grade splenic injuries. Journal of Trauma and Acute Care Surgery, 74(1), 100–104.
10. Coccolini, F., Montori, G., Catena, F., Kluger, Y., Biffl, W., Moore, E. E., Reva, V., Bing, C., Bala, M., & Fugazzola, P. (2017). Splenic trauma: WSES classification and guidelines for adult and pediatric patients. World Journal of Emergency Surgery, 12, 1–26.
11. Koide, Y., Okada, T., Yamaguchi, M., Sugimoto, K., & Murakami, T. (2024). The management of splenic injuries. Interventional Radiology, 9(3), 149–155.
12. Garber, B. G., Mmath, B. P., Fairfull-Smith, R. J., & Yelle, J.-D. (2000). Management of adult splenic injuries in Ontario: a population-based study. Canadian Journal of Surgery, 43(4), 283.
13. Nasr, W. I., Collins, C. L., & Kelly, J. J. (2004). Feasibility of laparoscopic splenectomy in stable blunt trauma: a case series. Journal of Trauma and Acute Care Surgery, 57(4), 887–889.
14. Qu, Y., Ren, S., Li, C., Qian, S., & Liu, P. (2013). Management of postoperative complications following splenectomy. International Surgery, 98(1), 55–60.
15. Stassen, N. A., Bhullar, I., Cheng, J. D., Crandall, M. L., Friese, R. S., Guillamondegui, O. D., Jawa, R. S., Maung, A. A., Rohs Jr, T. J., & Sangosanya, A. (2012). Selective nonoperative management of blunt splenic injury: an Eastern Association for the Surgery of Trauma practice management guideline. Journal of Trauma and Acute Care Surgery, 73(5), S294–S300.
16. Olthof, D. C., Joosse, P., Van Der Vlies, C. H., De Haan, R. J., & Goslings, J. C. (2013). Prognostic factors for failure of nonoperative management in adults with blunt splenic injury: a systematic review. Journal of Trauma and Acute Care Surgery, 74(2), 546–557.
17. Bugaev, N., Breeze, J. L., Daoud, V., Arabian, S. S., & Rabinovici, R. (2014). Management and outcome of patients with blunt splenic injury and preexisting liver cirrhosis. Journal of Trauma and Acute Care Surgery, 76(6), 1354–1361.
18. Bhullar, I. S., Frykberg, E. R., Tepas III, J. J., Siragusa, D., Loper, T., & Kerwin, A. J. (2013). At first blush: absence of computed tomography contrast extravasation in Grade IV or V adult blunt splenic trauma should not preclude angioembolization. Journal of Trauma and Acute Care Surgery, 74(1), 105–112.
19. Quencer, K. B., & Smith, T. A. (2019). Review of proximal splenic artery embolization in blunt abdominal trauma. CVIR Endovascular, 2, 1–12.