TRAUMA SERVICES B.C.
SPECIALIST TRAUMA ADVISORY NETWORK

THORACO-ABDOMINAL TRAUMA
SPECIALIST ADVISORY GROUP

CLINICAL PRACTICE GUIDELINE
FOR THE MANAGEMENT OF

BLUNT SPLENIC INJURY
IN ADULTS 16 YEARS OF AGE OR OLDER

Version 2.2
February 2019
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GUIDELINE DEVELOPMENT GROUP

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Lonne Clark (Clearview Consultants)
PURPOSE

The purpose of this clinical practice guideline (CPG) is to review best evidence and generate expert consensus on recommendations for the management of isolated blunt splenic trauma in adult patients (age ≥16) in B.C.

KEY MANAGEMENT QUESTIONS

I. INITIAL ASSESSMENT AND MANAGEMENT
   1. What are key considerations in the initial assessment and management of patients with suspected or confirmed blunt splenic injury?

II. OPERATIVE MANAGEMENT
   2. What are the indications for operative management (OM) of blunt splenic injuries?

I. NON-OPERATIVE MANAGEMENT
   3. What are the indications for non-operative management (NOM) in blunt splenic injuries?

II. ANGIOGRAPHY/ANGIOEMBOLIZATION
   4. What are the indications for angiography/angioembolization (AG/AE) in blunt splenic injuries?
   5. With regard to selective versus non-selective angioembolization, what is the preferred approach to angioembolization in splenic injuries?

III. TRANSFER TO HIGHER LEVEL OF CARE
   6. What are the indications for transfer of patients with blunt splenic injuries to a higher-level trauma center?

IV. ACUTE HOSPITAL CARE
   7. What type and duration of monitoring are necessary for patients with blunt splenic injuries?
   8. When is supplementary imaging required in the hospitalized patient?
   9. What activity restrictions should be imposed on patients with blunt splenic injuries, in hospital and post-discharge?

V. VENOUS THROMBOEMBOLISM (VTE) PROPHYLAXIS
10. What is the optimal timing for initiating deep vein thrombosis (DVT) prophylaxis in patients with blunt splenic injuries?

VI. OVERWELMING POST SPLENECTOMY INFECTION (OPSI) PROPHYLAXIS
11. Which vaccinations should be administered and when in patients with blunt splenic injuries?

VII. POST HOSPITAL CARE
12. What is the optimal timing for repeat imaging after blunt splenic injury? Which imaging modality should be used to follow-up blunt splenic injury?
13. What is the preferred management of delayed pseudoaneurysm?
# GUIDELINES REFERENCED

<table>
<thead>
<tr>
<th>Organization</th>
<th>Title, Year</th>
<th>Citation</th>
<th>Grading System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern Association for the Surgery of Trauma</td>
<td>Selective nonoperative management of blunt splenic injury, 2012&lt;sup&gt;1&lt;/sup&gt;</td>
<td>EAST</td>
<td><strong>Level 1</strong>: Convincingly justifiable based on available scientific information alone. Supported by prospective randomized studies or prospective, noncomparative studies or retrospective series with controls. <strong>Level 2</strong>: Reasonably justifiable by available scientific evidence and strongly supported by expert opinion. Supported by prospective, noncomparative studies or retrospective series with controls or a preponderance of retrospective analyses. <strong>Level 3</strong>: Supported by available data but lacking adequate evidence. Supported by retrospective analyses.</td>
</tr>
<tr>
<td>World Society for Emergency Surgery</td>
<td>Splenic trauma, 2017&lt;sup&gt;2&lt;/sup&gt;</td>
<td>WSES</td>
<td>1A: Strong recommendation, high-quality evidence 1B: Strong recommendation, moderate-quality evidence 1C: Strong recommendation, low-quality or very low-quality evidence 2A: Weak recommendation, high-quality evidence 2B: Weak recommendation, moderate-quality evidence 2C: Weak recommendation, low-quality or very low-quality evidence</td>
</tr>
</tbody>
</table>
### DEFINITIONS

**American Association for the Surgery of Trauma Spleen Injury Scale**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Injury type</th>
<th>Description of injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Hematoma</td>
<td>Subcapsular, &lt;10% surface area</td>
</tr>
<tr>
<td></td>
<td>Laceration</td>
<td>Capsular tear, &lt;1cm parenchymal depth</td>
</tr>
<tr>
<td>II</td>
<td>Hematoma</td>
<td>Subcapsular, 10%-50% surface area intraparenchymal, &lt;5 cm in diameter</td>
</tr>
<tr>
<td></td>
<td>Laceration</td>
<td>Capsular tear, 1-3cm Parenchymal depth that does not involve a trabecular vessel</td>
</tr>
<tr>
<td>III</td>
<td>Hematoma</td>
<td>Subcapsular, &gt;50% surface area or expanding; ruptured subcapsular or parenchymal hematoma; intraparenchymal hematoma ≥ 5 cm or expanding</td>
</tr>
<tr>
<td></td>
<td>Laceration</td>
<td>&gt;3 cm parenchymal depth or involving trabecular vessels</td>
</tr>
<tr>
<td>IV</td>
<td>Laceration</td>
<td>Laceration involving segmental or hilar vessels producing major devascularization (&gt;25% of spleen)</td>
</tr>
<tr>
<td>V</td>
<td>Laceration</td>
<td>Completely shattered spleen</td>
</tr>
<tr>
<td></td>
<td>Vascular</td>
<td>Hilar vascular injury with devascularizes spleen</td>
</tr>
</tbody>
</table>

The injury grade can be estimated from the radiology report. The radiologist should report:

i. the presence/absence of hilar involvement,
ii. the percentage of splenic parenchymal injury/hematoma (<25%, 25-50%, >50%),
iii. the presence of active bleeding, and
iv. presence of a pseudoaneurysm.

Generally, Grade 1 and 2 injuries are considered **low grade injuries** while Grade 3-5 are considered **high grade injuries**.
SUMMARY OF RECOMMENDATIONS

All recommendations are newly drafted by the Thoraco-Abdominal SAG, unless indicated otherwise.

I. INITIAL ASSESSMENT AND MANAGEMENT
   A. Initial resuscitation and management of the patient with blunt abdominal trauma should follow the Advanced Trauma Life Support® (ATLS®) principles.
   B. In centres with surgical capability, the on-call general surgeon should be consulted promptly when a splenic injury is suspected or proven.

II. OPERATIVE MANAGEMENT
   A. In centres with general surgical capability, urgent splenectomy should be performed for a hemodynamically unstable patient with a splenic injury who is not responding to appropriate resuscitation.
   B. Grade or severity of splenic injury is not, in and of itself, an indication for surgical management of the injured spleen. The decision to proceed to splenectomy should be based on the clinical presentation of the patient and situational context, which includes the capabilities of the site, resources available, presence of other injuries, transport availability, and transfer related issues.
   C. A general surgeon should be involved early in decision-making for suspected or proven splenic injury. Tele-conferencing through Patient Transfer Network (PTN) to discuss optimal management (transport vs. splenectomy) should be performed. The conference call should include the sending physician, the receiving general surgeon and the receiving Trauma Team Leader (TTL) at the higher level of care (HLOC) trauma referral centre.

III. NON-OPERATIVE MANAGEMENT
   A. A trial of non-operative management (NOM) for splenic injury is indicated in patients with proven splenic injury who are hemodynamically stable after appropriate resuscitation. There are no absolute contraindications to a trial of NOM of known splenic injury in the hemodynamically stable or stabilized patient.
   B. Hemodynamically stable patients with negligible risk* of ongoing or delayed hemorrhage may be safely managed, without higher level of care (HLOC) transfer, in a rural/remote facility provided at least 2 units of packed red blood cells are available. This management plan should be reviewed with a general surgeon and Trauma Team Leader (TTL) on call at the HLOC trauma referral centre in sites without surgical capabilities.

   * CT-confirmed Grade 1-2 splenic injuries without evidence of active haemorrhage or pseudoaneurysm, anticoagulated patient, associated major injury, age ≥65 or limited physiologic reserve.
   C. NOM of Grade 3-5 splenic injuries should only be considered in a hospital that has capabilities for physiologic monitoring and serial clinical evaluations by a general surgeon are possible. The hospital also needs 4 or more units of blood available, CT imaging, and 24-7 operating room access. Access to 24-7 interventional radiology for angiography/angioembolization is preferred but not essential. For transfer indications, see IV. TRANSFER TO HIGHER LEVEL OF CARE below.
IV. ANGIOGRAPHY/ANGIOEMBOLIZATION

A. Emergent angiography/angioembolization is indicated in hemodynamically unstable patients with immediate access to interventional radiology who have responded to appropriate resuscitation and demonstrate active vascular extravasation on contrast CT. The higher level of care transfer of splenic injury patients that are or have been unstable for the purposes of urgent angioembolization is not recommended if the patient is in a centre with general surgical capability and can perform splenectomy.

B. Emergent angiography/angioembolization is indicated in hemodynamically stable patients with major free extravasation not likely to abate.

C. Angioembolization within 72 hours is indicated in hemodynamically stable or stabilized patients with pseudoaneurysm or arterio-venous fistula identified on CT or ultrasound imaging.

D. Patients with splenic injury demonstrating contrast blush on CT are at an elevated risk for failing non-operative management (NOM). The consulting surgeon and interventional radiologist should communicate once initial imaging is completed and collaborate on a management plan in the event of failure of NOM.

E. In centres without interventional radiology capability, if follow-up imaging demonstrates an indication for angioembolization, patients should be transferred under the care of a general surgeon to a higher level of care (HLOC) trauma referral centre for this procedure within 48 hours.

F. In the presence of a single vascular abnormality (contrast blush, pseudo-aneurysms, and arterio-venous fistula) in minor and moderate injuries, the currently available literature is inconclusive regarding whether proximal or distal embolization should be used. In general, selective angioembolization is preferred, where safe and feasible. [Adopted from WSES with modification]

V. TRANSFER TO HIGHER LEVEL OF CARE (HLOC)

Immediate Transfer (< 24 hours):

A. Patients who are hemodynamically stable with associated major injuries requiring urgent higher level of care (e.g. traumatic brain injury) should be transferred promptly to a Level 1 or 2 trauma centre.

B. Hemodynamically stable patients with negligible risk* of ongoing or delayed hemorrhage may be safely managed, without higher level of care (HLOC) transfer, in a rural/remote facility provided at least 2 units of packed red blood cells are available. This management plan should be reviewed with a general surgeon and Trauma Team Leader (TTL) on call at the HLOC trauma referral centre in sites without surgical capabilities.

* CT-confirmed Grade 1-2 splenic injuries without evidence of active haemorrhage or pseudoaneurysm, anticoagulated patient, associated major injury, age ≥65 or limited physiologic reserve.

C. Patients with Grade 3-5 splenic injuries or associated major injury should be transferred to an appropriate trauma referral centre. Centres receiving these patients should have IR capability to facilitate angioembolization if needed. A general surgeon must be actively involved in the transfer process and the ongoing care of transferred patients.
D. The HLOC transfer of splenic injury patients that are or have been unstable for the purposes of urgent angioembolization is not recommended if the patient is in a centre with general surgical capability and can perform splenectomy.

E. For patients undergoing emergent splenectomy prior to HLOC transfer, arrangements for transfer through Patient Transfer Network (PTN) should be made as early as possible, preferably pre-operatively or intraoperatively to avoid delay.

   Delayed Transfer (> 24 hours):

F. In centres without interventional radiology capability, if follow-up imaging demonstrates an indication for angioembolization, patients should be transferred under the care of a general surgeon to a HLOC trauma referral centre for this procedure within 48 hours.

VI. ACUTE HOSPITAL CARE

A. Patients with Grade 1-2 splenic injuries can be monitored in a general surgery ward. The patient should have good IV access and assessed frequently for vital signs.

B. Patients with Grade 3-5 splenic injuries undergoing non-operative management (NOM) should be observed initially in a monitored intermediate care unit or intensive care unit (ICU). Appropriate initial monitoring includes the capacity to provide hourly vital signs as well as cardiac, oxygen saturation and urine output monitoring. Serial examination by a general surgeon is essential.

C. Hemoglobin should be monitored at regular intervals until stabilized.

D. It is recommended that therapeutic anticoagulation be reversed promptly in patients with high risk splenic injury, unless the risk of reversal is considered higher than the risk of splenic hemorrhage.

E. Repeat CT imaging in hemodynamically stable patients should be obtained within 72 hours post-injury for Grade 3-5 splenic injuries. Any changes in clinical status should prompt urgent reassessment, including laboratory investigations and/or CT as appropriate.

F. There is no need to restrict mobilization in patients with splenic injury and early mobilization is encouraged. Patients with high risk injuries* should remain supervised until assessed as safe to ambulate independently off unit.

   *CT-confirmed Grade 3-5 splenic injuries, particularly with evidence of active haemorrhage or pseudoaneurysm, anticoagulated patient, associated major injury, age ≥65 or limited physiologic reserve.

G. Post-discharge, patients with Grade 3-5 splenic injuries should avoid contact sports or vigorous activities for at least 8 weeks. Patients with Grade 3-5 splenic injuries should be re-imaged prior to resuming high-risk activities.

VII. VENOUS THROMBOEMBOLISM (VTE) PROPHYLAXIS

A. Pharmacologic prophylaxis to prevent venous thromboembolism (VTE) can be used for patients with isolated blunt splenic injuries without increasing the failure rate of non-operative management. Although the optimal timing of safe initiation has not been determined, deep vein thrombosis (DVT) prophylaxis may be started as soon as possible after trauma and within 12 hours for every Grade of splenic injury (e.g. 36 hours for Grade 3 injury) or sooner if hemoglobin is stable. [Adopted from EAST and WSES with modification]
B. Mechanical prophylaxis should be used in all patients with absolute contraindication to pharmacologic prophylaxis, except in patients with lower extremity trauma in which case mechanical prophylaxis is not efficacious. [Adopted from WSES with modification]

VIII. OVERWHELMING POST SPLENECTOMY INFECTION (OPSI) PROPHYLAXIS

A. Patients should receive immunization against the encapsulated bacteria (*S. pneumoniae*, *H. influenzae*, and *N. meningitidis*) post-splenectomy or post-proximal angioembolization. Refer to national guidelines for vaccine dosage. [Adopted from WSES with modification]

B. Revaccination against pneumococcus is recommended every 10 years.

C. Vaccination should be administered >14 days post-splenectomy/embolization. For patients where follow-up is a concern, vaccination prior to discharge is recommended. [Adopted from EAST and WSES]

D. Regarding infection prophylaxis in asplenic and hyposplenic adult patients:
   - immunization against seasonal flu is recommended;
   - malaria prophylaxis is strongly recommended for travellers;
   - antibiotic therapy should be strongly considered in the event of any sudden onset of unexplained fever, malaise, chills or other constitutional symptoms, especially when medical review is not readily accessible; and
   - primary care providers should be aware of the splenectomy/angioembolization.
[Adopted from WSES]

IX. POST HOSPITAL CARE

A. Post-discharge outpatient follow-up with imaging is recommended within 12 weeks. Patients with Grade 1-2 injuries should avoid contact sports or vigorous activities for at least 8 weeks. Grade 3-5 splenic injuries should be re-imaged at 8 weeks if the patient plans to resume high-risk activities to rule out pseudoaneurysm, subcapsular hematoma, etc.

B. Abdominal CT can be used for follow-up imaging and may allow for earlier return to sports activities. [Adapted from WSES]

C. If a new pseudoaneurysm is noted on follow-up imaging, discussion with general surgery is recommended to determine best management, e.g. serial imaging vs. embolization.
SCIENTIFIC DISCUSSION

All recommendations are newly drafted by the Thoraco-Abdominal SAG, unless indicated otherwise.

I. INITIAL ASSESSMENT AND MANAGEMENT

**KMQ-1.** What are key considerations in the initial assessment and management of patients with suspected or confirmed blunt splenic injury?

**RECOMMENDATIONS**

A. Initial resuscitation and management of the patient with blunt abdominal trauma should follow the Advanced Trauma Life Support® (ATLS®) principles.

B. In centers with surgical capability, the on-call general surgeon should be consulted promptly when a splenic injury is suspected or proven.

**KNOWLEDGE SYNTHESIS**

<table>
<thead>
<tr>
<th>External Recommendations</th>
<th>SAG’s Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Developed new recommendations based on expert opinion of the SAG and the BC trauma system.</td>
</tr>
</tbody>
</table>
II. OPERATIVE MANAGEMENT

KMQ-2. What are the indications for operative management (OM) of blunt splenic injuries?

RECOMMENDATIONS
A. In centres with general surgical capability, urgent splenectomy should be performed for a hemodynamically unstable patient with a splenic injury who is not responding to appropriate resuscitation.

B. Grade or severity of splenic injury is not, in and of itself, an indication for surgical management of the injured spleen. The decision to proceed to splenectomy should be based on the clinical presentation of the patient and situational context, which includes the capabilities of the site, resources available, presence of other injuries, transport availability, and transfer related issues.

C. A general surgeon should be involved early in decision-making for suspected or proven splenic injury. Tele-conferencing through Patient Transfer Network (PTN) to discuss optimal management (transport vs. splenectomy) should be performed. The conference call should include the sending physician, the receiving general surgeon and the receiving Trauma Team Leader (TTL) at the higher level of care (HLOC) trauma referral centre.

KNOWLEDGE SYNTHESIS

<table>
<thead>
<tr>
<th>External Recommendation</th>
<th>SAG’s Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Patients who have diffuse peritonitis or who are hemodynamically unstable after blunt abdominal trauma should be taken urgently for laparotomy. [EAST: Level 1]</td>
<td>Accepted hemodynamic instability as an indicator of OM but rejected diffuse peritonitis and bowel evisceration (A).</td>
</tr>
<tr>
<td>• OM should be performed in patients with hemodynamic instability and/or with associated lesions like peritonitis or bowel evisceration or impalement requiring surgical exploration. [WSES: 2A]</td>
<td>Accepted continued hemodynamic instability as an indicator of OM (A). Emphasized a balance of clinical presentation and other situational contexts, including site-specific resources and feasibility of transfer/transport to reflect the BC trauma system (B).</td>
</tr>
<tr>
<td>• Splenectomy should be performed when NOM with AG/AE failed, and patient remains hemodynamically unstable or shows a significant drop in hematocrit levels or continuous transfusion are required. [WSES: 2A]</td>
<td>Accepted the concept of resource requirements for OM. Emphasized early consult with general surgery and initiation of PTN call to discuss transport versus onsite</td>
</tr>
<tr>
<td>External Recommendation</td>
<td>SAG’s Rationale</td>
</tr>
<tr>
<td>--------------------------</td>
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</tr>
<tr>
<td></td>
<td>splenectomy and to encourage site-to-site communication.</td>
</tr>
</tbody>
</table>
III. NON-OPERATIVE MANAGEMENT

KMQ-3. What are the indications for non-operative management (NOM) in blunt splenic injuries?

RECOMMENDATIONS

A. A trial of non-operative management (NOM) for splenic injury is indicated in patients with proven splenic injury who are hemodynamically stable after appropriate resuscitation. There are no absolute contraindications to a trial of NOM of known splenic injury in the hemodynamically stable or stabilized patient.

B. Hemodynamically stable patients with negligible risk* of ongoing or delayed hemorrhage may be safely managed, without higher level of care (HLOC) transfer, in a rural/remote facility provided at least 2 units of packed red blood cells are available. This management plan should be reviewed with a general surgeon and Trauma Team Leader (TTL) on call at the HLOC trauma referral centre in sites without surgical capabilities.

* CT-confirmed Grade 1-2 splenic injuries without evidence of active haemorrhage or pseudoaneurysm, anticoagulated patient, associated major injury, age ≥65 or limited physiologic reserve.

C. NOM of Grade 3-5 splenic injuries should only be considered in a hospital that has capabilities for physiologic monitoring and serial clinical evaluations by a general surgeon are possible. The hospital also needs 4 or more units of blood available, CT imaging, and 24-7 operating room access. Access to 24-7 interventional radiology for angiography/angioembolization is preferred but not essential. For transfer indications, see IV. TRANSFER TO HIGHER LEVEL OF CARE below.

KNOWLEDGE SYNTHESIS

<table>
<thead>
<tr>
<th>External Recommendations</th>
<th>SAG’s Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indications for NOM</strong></td>
<td>Adapated EAST and WSES recommendations to create a new recommendation (A) indicating a trial of NOM in patients who are hemodynamically stable after resuscitation.</td>
</tr>
<tr>
<td>• A routine laparotomy is not indicated in the hemodynamically stable patient without peritonitis presenting with an isolated splenic injury. [EAST: Level 2]</td>
<td></td>
</tr>
<tr>
<td>• NOM in splenic injuries is contraindicated in the setting of unresponsive hemodynamic instability or other indicators for laparotomy (peritonitis, hollow organ injuries, bowel evisceration, impalement). [WSES: 1A]</td>
<td></td>
</tr>
<tr>
<td><strong>Non-contraindications for a trial of NOM</strong></td>
<td>Consolidated the external recommendations into a single statement (A) regarding the absence of absolute contraindications to a trial of NOM in the hemodynamically stable or stabilized patient.</td>
</tr>
<tr>
<td>• The severity of splenic injury (as suggested by CT grade or degree of hemoperitoneum), neurologic status, age &gt;55 and/or the presence of associated injuries are not contraindications to a trial of non-operative management in a hemodynamically stable patient. [EAST: Level 2]</td>
<td></td>
</tr>
</tbody>
</table>
**External Recommendations**

- Age above 55 years old alone, large hemoperitoneum alone, hypotension before resuscitation, GCS < 12 and low-hematocrit level at the admission, associated abdominal injuries, blush at CT scan, anticoagulation drugs, HIV disease, drug addiction, cirrhosis and need for blood transfusions should be taken into account, but they are not absolute contraindications for NOM. [WSES: 2B]
- Patients with hemodynamic stability and absence of other abdominal organ injuries requiring surgery should undergo an initial attempt of NOM irrespective of injury grade. [WSES: 2A]

**Other considerations: Monitoring and OR availability**

- Nonoperative management of splenic injuries should only be considered in an environment that provides capabilities for monitoring, serial clinical evaluations, and an operating room available for urgent laparotomy. [EAST: Level 2]
- NOM of moderate or severe spleen injuries should be considered only in an environment that provides capability for patient intensive monitoring, AG/AE, an immediately available OR and immediate access to blood and blood product or alternatively in the presence of a rapid centralization system and only in patients with stable or stabilized hemodynamic and absence of other internal injuries requiring surgery. [WSES: 2A]
- Strong evidence exists that age above 55 years old, high ISS, and moderate to severe splenic injuries are prognostic factors for NOM failure. These patients require more intensive monitoring and higher index of suspicion. [WSES: 2B]

Incorporated concepts from EAST and WSES statements. The concept of negligible risk of ongoing or delayed hemorrhage was introduced to indicate the types of splenic injuries that can be safely managed in a rural/remote facility with consult with a HLOC centre (B).

Adopted WSES statement regarding NOM of moderate to severe splenic injuries and added site-specific requirements, such as access to radiology, interventional radiology and surgical capabilities. Provincial communication pathways for trauma were outlined and emphasized. (C)

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**Additional Literature Support**

**What is the success rate of non-operative management of blunt splenic injuries?**

Overall reported success rate of observational management (without angiography) is 92-96 %.<sup>3</sup>,<sup>4</sup>,<sup>5</sup>,<sup>6</sup>

<table>
<thead>
<tr>
<th>Source (lead author, year)</th>
<th>Grade 1</th>
<th>Grade 2</th>
<th>Grade 3</th>
<th>Grade 4</th>
<th>Grade 5*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brillantino 2016&lt;sup&gt;5&lt;/sup&gt;</td>
<td>100 %</td>
<td>95.4 %</td>
<td>95 %</td>
<td>90.9 %</td>
<td>83.3 %</td>
</tr>
<tr>
<td>Brault-Noble 2012&lt;sup&gt;3&lt;/sup&gt;</td>
<td>100 %</td>
<td>98 %</td>
<td>84 %</td>
<td>79 %</td>
<td>78 %</td>
</tr>
<tr>
<td>Bhullar 2012&lt;sup&gt;7&lt;/sup&gt;</td>
<td>99 %</td>
<td>98 %</td>
<td>94 %</td>
<td>77 %</td>
<td>37 %</td>
</tr>
<tr>
<td>McCray 2008&lt;sup&gt;4&lt;/sup&gt;</td>
<td>100 %</td>
<td>99 %</td>
<td>94 %</td>
<td>84 %</td>
<td>100 %</td>
</tr>
</tbody>
</table>

* Grade 5 blunt splenic injuries are rare, resulting in a greater variability in success rate reported in studies.
Recent success rate of non-operative management (NOM) (i.e. observational management only + NOM with angioembolization) has been reported in the range of 93-100 %\(^6,^8\).

**What are the complications of non-operative management of blunt splenic injury?**

Complications in NOM in blunt splenic injury include progression to splenectomy, hemodynamic instability and/or evidence of ongoing bleeding, and delayed laparotomy for missed associated injury, resulting in re-admission or emergency laparotomy.

Overall reported failure rate of NOM is 4-15 % (according to a 2017 review of studies published 2000 onwards\(^9\)), with higher rates reported for high grade injuries:

**Failure rate of non-operative management of splenic trauma by injury grade**

<table>
<thead>
<tr>
<th>Source (lead author, year)</th>
<th>Grade 1</th>
<th>Grade 2</th>
<th>Grade 3</th>
<th>Grade 4</th>
<th>Grade 5*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scarborough 2016(^10)</td>
<td>--</td>
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<td>--</td>
<td>17.8 %</td>
<td>29.0 %</td>
</tr>
<tr>
<td>Miller 2014(^11)</td>
<td>--</td>
<td>--</td>
<td>3 %</td>
<td>7 %</td>
<td>50 %</td>
</tr>
<tr>
<td>Skattum 2013(^12)</td>
<td>6 %</td>
<td>0 %</td>
<td>5 %</td>
<td>2 %</td>
<td>25 %</td>
</tr>
<tr>
<td>Bhullar 2012(^7)</td>
<td>1 %</td>
<td>2 %</td>
<td>5 %</td>
<td>11 %</td>
<td>26 %</td>
</tr>
<tr>
<td>Velmahos 2010(^13)</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>34.5 %</td>
<td>60 %</td>
</tr>
<tr>
<td>Requarth 2011(^14)</td>
<td>4.3 %</td>
<td>9.1 %</td>
<td>19.9 %</td>
<td>43.7 %</td>
<td>83.1 %</td>
</tr>
<tr>
<td>(meta-analysis of studies published 1996-2000)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peitzman 2000(^15)</td>
<td>5 %</td>
<td>10 %</td>
<td>20 %</td>
<td>33 %</td>
<td>75 %</td>
</tr>
</tbody>
</table>

* Grade 5 blunt splenic injuries are rare, resulting in a greater variability in success rate reported in studies

**What is the risk (probability) of delayed hemorrhage following non-operative management of splenic injuries?**

Probability of delayed hemorrhage after NOM ranges from 0-15 %\(^6,^16,^17\), with a higher probability in higher Grade injuries.\(^2\)

It is difficult to distinguish between delayed hemorrhage and hemorrhage that was missed on the initial CT. This is particularly the case with older studies that used older CT technology. For this reason, more recent studies that clearly indicate delayed hemorrhage have been consulted.

**What is the rate of spontaneous resolution of active hemorrhage detected as contrast blush on initial CT scan?**

Probability of blush detected on CT leading to absence of extravasation on angiography ranges from 2.3-47 %\(^18,^19,^20\).

One retrospective study showed 100% (3/3) patients with contrast blush on initial CT had no blush on post-transfer repeat CT.\(^19\)

Conservatively estimated, NOM of splenic injury results in a success rate of >98% for Grade 1-2 injuries, >90% for Grade 3 injuries, and >75% for Grade 4-5 injuries. Angiography is variably used to achieve these rates.
IV. ANGIOGRAPHY / ANGIOEMBOLIZATION

KMQ-4. What are the indications for angiography/angioembolization (AG/AE) in blunt splenic injuries?

RECOMMENDATIONS

A. Emergent angiography/angioembolization is indicated in hemodynamically unstable patients with immediate access to interventional radiology who have responded to appropriate resuscitation and demonstrate active vascular extravasation on contrast CT. The higher level of care transfer of splenic injury patients that are or have been unstable for the purposes of urgent angioembolization is not recommended if the patient is in a centre with general surgical capability and can perform splenectomy.

B. Emergent angiography/angioembolization is indicated in hemodynamically stable patients with major free extravasation not likely to abate.

C. Angioembolization within 72 hours is indicated in hemodynamically stable or stabilized patients with pseudoaneurysm or arterio-venous fistula identified on CT or ultrasound imaging.

D. Patients with splenic injury demonstrating contrast blush on CT are at an elevated risk for failing non-operative management (NOM). The consulting surgeon and interventional radiologist should communicate once initial imaging is completed and collaborate on a management plan in the event of failure of NOM.

E. In centres without interventional radiology capability, if follow-up imaging demonstrates an indication for angioembolization, patients should be transferred under the care of a general surgeon to a higher level of care (HLOC) trauma referral centre for this procedure within 48 hours.

KNOWLEDGE SYNTHESIS

<table>
<thead>
<tr>
<th>External Recommendations</th>
<th>SAG’s Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indications</strong></td>
<td></td>
</tr>
<tr>
<td>• Angiography should be considered for patients with American Association for the Surgery of Trauma (AAST) grade of greater than III injuries, presence of a contrast blush, moderate hemoperitoneum, or evidence of ongoing splenic bleeding. [EAST: Level 2]</td>
<td>Accepted hemodynamic stability (including after resuscitation and not likely to abate) and diagnostic imaging abnormalities (i.e. active vascular extravasation, pseudoaneurysm, and arterio-venous fistula) as indicators for IR consult for AG/AE (A, B, C).</td>
</tr>
<tr>
<td>• AG/AE may be considered the first-line intervention in patients with hemodynamic stability and arterial blush on CT scan irrespective from injury grade. [WSES: 2B]</td>
<td>Contrast blush on CT emphasized as an elevated risk for NOM failure.</td>
</tr>
<tr>
<td>• AG/AE may be performed in hemodynamically stable and rapid responder patients with moderate and severe lesions and in those with vascular injuries at CT scan (contrast blush, pseudoaneurysms and arterio-venous fistula). [WSES: 2A]</td>
<td>Emphasized interdisciplinary collaboration between consulting surgeon and interventional radiologist (D).</td>
</tr>
</tbody>
</table>
### External Recommendations

<table>
<thead>
<tr>
<th>SAG’s Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AG/AE</strong> should be considered in all hemodynamically stable patients with WSES grade III lesions, regardless with the presence of CT blush. [WSES: 1B]</td>
</tr>
<tr>
<td><strong>AG/AE</strong> could be considered in patients undergoing to NOM, hemodynamically stable with signs of persistent hemorrhage regardless of the presence of CT blush once excluded extrasplenic source of bleeding. [WSES: 1C]</td>
</tr>
</tbody>
</table>

### Contraindications

| Emphasized interdisciplinary collaboration between consulting surgeon and interventional radiologist in the clinical decision-making (D). |
| **Contrast blush on CT scan alone is not an absolute indication for an operation or angiographic intervention. Factors such as patient age, grade of injury, and presence of hypotension need to be considered in the clinical management of these patients.** [EAST: Level 3] |
| **Hemodynamically stable patients with WSES grade II lesions without blush should not undergo routine AG/AE but may be considered for prophylactic proximal embolization in presence of risk factors for NOM failure.** [WSES: 2B] |

### Management Pathway

| Outlined transfer requirements to HLOC and emphasized inter-facility communication. (E) |
| **In patients with bleeding vascular injuries and in those with intraperitoneal blush, AG/AE should be performed as part of NOM only in centers where AG/AE is rapidly available. In other centers and in case of rapid hemodynamic deterioration, OM should be considered.** [WSES: 2B] |

### Additional Literature Support

**What is the success rate of angiography/angioembolizations in blunt splenic injuries?**

Success rate of AG/AE range from 73-100%.\(^{21}\)

In severe injuries (Grades 4-5), difference in success rate between NOM with and without angioembolization can be as great as 78.4 %.\(^{6}\) Failure rate of NOM without AG/AE can be as high as 26% in these injuries.\(^{22}\)

Conflicting evidence exists for the benefits of angioembolization in preventing splenectomy.\(^{23,24}\)

**What are the complications of angiography/angioembolizations in blunt splenic injuries?**

Major complications of AE include: delayed bleeding, total or subtotal splenic infarction, splenic abscesses, acute renal insufficiency, pseudocysts, and puncture-related complications. Rate of major complications range from 3.7-28.5 %.\(^{1,2}\)

Minor complications include fever, pleural effusion, coil migration, and partial splenic infarction. Rate of minor complications range from 23-61 %,\(^{1,2}\)

---

[Image 46x25 to 151x69]
No randomized control trials exist comparing morbidity related to AG/AE and NOM without AG/AE.

A large prospective study found AG/AE-related morbidity of 47% compared to morbidity of 10% in NOM without AG/AE.\(^6\)

A large study of post-discharge complications in patients who received NOM found higher rate of thirty-day readmission among patients who received NOM with AE than patients who did not receive AE (12.8% vs. 7.4%, \(p=0.002\)).\(^{25}\)

**KMQ-5.** With regard to selective versus non-selective angioembolization, what is the preferred approach to angioembolization in splenic injuries?

**RECOMMENDATIONS**

F. In the presence of a single vascular abnormality (contrast blush, pseudo-aneurysms, and arterio-venous fistula) in minor and moderate injuries, the currently available literature is inconclusive regarding whether proximal or distal embolization should be used. In general, selective angioembolization is preferred, where safe and feasible. [Adopted from WSES with modification]

**KNOWLEDGE SYNTHESIS**

<table>
<thead>
<tr>
<th>External Recommendations</th>
<th>SAG’s Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>• In the presence of a single vascular abnormality (contrast blush, pseudo-aneurysms, and arterio-venous fistula) in minor and moderate injuries, the currently available literature is inconclusive regarding whether proximal or distal embolization should be used. In the presence of multiple splenic vascular abnormalities or in the presence of a severe lesion, proximal or combined AG/AE should be used, after confirming the presence of a permissive pancreatic vascular anatomy. [WSES: 1C]</td>
<td>Adopted first sentence. Replaced second sentence with preference for selective (i.e. proximal) angioembolization due to fewer minor complications reported in retrospective cohort studies (see below).</td>
</tr>
</tbody>
</table>

**Additional Literature Support**

*What is the effectiveness of selective versus non-selective angioembolization? What are the complications?*

No prospective studies or randomized controlled trials available on the subject.

No significant difference observed in overall failure rate between distal and proximal embolization.

No significant difference has been observed between proximal and distal embolization for incidence of major infarctions, infections or re-bleeding.

Higher rate of minor complications has been reported in distal than in proximal embolization (see table below). Proximal embolization is also protective in high grade injuries.\(^{26}\)
### Complications in proximal vs. distal splenic embolization

<table>
<thead>
<tr>
<th>Complication</th>
<th>Proximal Embolization</th>
<th>Distal Embolization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor infarction</td>
<td>0.0-8.4 %\textsuperscript{27}</td>
<td>14.3-19.8 %\textsuperscript{27}</td>
</tr>
<tr>
<td>Re-bleeding</td>
<td>2.2-2.8 %\textsuperscript{27}</td>
<td>1.6-4.5 %\textsuperscript{27}</td>
</tr>
</tbody>
</table>
V. **TRANSFER TO HIGHER LEVEL OF CARE (HLOC)**

**KMQ-6.** What are the indications for transfer of patients with blunt splenic injuries to a higher-level trauma center?

**RECOMMENDATIONS**

**Immediate Transfer (< 24 hours):**

A. Patients who are hemodynamically stable with associated major injuries requiring urgent higher level of care (e.g. traumatic brain injury) should be transferred promptly to a Level 1 or 2 trauma centre.

B. Hemodynamically stable patients with negligible risk* of ongoing or delayed hemorrhage may be safely managed, without higher level of care (HLOC) transfer, in a rural/remote facility provided at least 2 units of packed red blood cells are available. This management plan should be reviewed with a general surgeon and Trauma Team Leader (TTL) on call at the HLOC trauma referral centre in sites without surgical capabilities.

   * CT-confirmed Grade 1-2 splenic injuries without evidence of active haemorrhage or pseudoaneurysm, anticoagulated patient, associated major injury, age ≥65 or limited physiologic reserve.

C. Patients with Grade 3-5 splenic injuries or associated major injury should be transferred to an appropriate trauma referral centre. Centres receiving these patients should have IR capability to facilitate angioembolization if needed. A general surgeon must be actively involved in the transfer process and the ongoing care of transferred patients.

D. The HLOC transfer of splenic injury patients that are or have been unstable for the purposes of urgent angioembolization is not recommended if the patient is in a centre with general surgical capability and can perform splenectomy.

E. For patients undergoing emergent splenectomy prior to HLOC transfer, arrangements for transfer through Patient Transfer Network (PTN) should be made as early as possible, preferably pre-operatively or intraoperatively to avoid delay.

**Delayed Transfer (> 24 hours):**

F. In centres without interventional radiology capability, if follow-up imaging demonstrates an indication for angioembolization, patients should be transferred under the care of a general surgeon to a HLOC trauma referral centre for this procedure within 48 hours.

**KNOWLEDGE SYNTHESIS**

<table>
<thead>
<tr>
<th>External Recommendations</th>
<th>SAG’s Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Recommendations regarding transfer to higher level of care were drafted, based on provincial realities and the expert opinion of the SAG.</td>
</tr>
</tbody>
</table>
VI. ACUTE HOSPITAL CARE

KMQ-7. What type and duration of monitoring are necessary for patients with blunt splenic injuries?

RECOMMENDATIONS

A. Patients with Grade 1-2 splenic injuries can be monitored in a general surgery ward. The patient should have good IV access and assessed frequently for vital signs.

B. Patients with Grade 3-5 splenic injuries undergoing non-operative management (NOM) should be observed initially in a monitored intermediate care unit or intensive care unit (ICU). Appropriate initial monitoring includes the capacity to provide hourly vital signs as well as cardiac, oxygen saturation and urine output monitoring. Serial examination by a general surgeon is essential.

C. Hemoglobin should be monitored at regular intervals until stabilized.

D. It is recommended that therapeutic anticoagulation be reversed promptly in patients with high risk splenic injury, unless the risk of reversal is considered higher than the risk of splenic hemorrhage.

KNOWLEDGE SYNTHESIS

External Recommendations | SAG’s Rationale
---|---
Clinical and laboratory observation associated [with] bed rest in moderate and severe lesions is the cornerstone in the first 48-72 hour follow-up. [WSES: 1C] | The only external recommendation for monitoring pertains to the first 48-72 hours. Created new recommendations outlining monitoring requirements based on expert opinion.

KMQ-8. When is supplementary imaging required in the hospitalized patient?

RECOMMENDATIONS

E. Repeat CT imaging in hemodynamically stable patients should be obtained within 72 hours post-injury for Grade 3-5 splenic injuries. Any changes in clinical status should prompt urgent reassessment, including laboratory investigations and/or CT as appropriate.

KNOWLEDGE SYNTHESIS

External Recommendations | SAG’s Rationale
---|---
After blunt splenic injury, clinical factors such as a persistent systemic inflammatory response, increasing/persistent abdominal pain, or an otherwise unexplained drop in hemoglobin should dictate the frequency of and need for follow-up imaging for a patient with blunt splenic injury. [EAST: Level 3]

CT scan repetition during the admission should be considered in patients with moderate and severe lesions or in decreasing hematocrit, in presence of vascular anomalies or underlying splenic pathology or coagulopathy, and in neurologically impaired patients. [WSES: 2A]

Developed umbrella phrase “any changes in clinical status” as potential indicator of repeat imaging or other investigations. Accepted WSES indication for repeat CT in higher grade injuries and added time frame within which to obtain the repeat scan based on evidence of delayed splenic pseudoaneurysm formation as early as 48 hours (see below) and on logistical realities of provincial trauma centres.

Additional Literature Support

What is the incidence of delayed splenic pseudoaneurysm formation by injury grade?

Timing of formation?

Overall rate of incidence of delayed splenic pseudoaneurysm formation ranges from 3.0-15.4 %\textsuperscript{17,28,29,30,31,32} to as high as 74 %.\textsuperscript{33}

A retrospective multicenter study\textsuperscript{30} found incidence of delayed splenic pseudoaneurysm formation in 17.7 % of patients treated with initial observation and 11.9 % of patients treated with early angioembolization.

Probability of delayed splenic pseudoaneurysm formation is greater in patients with high grade splenic injuries\textsuperscript{29}—as high as 50 % in Grade 4-5 injuries versus 24 % in Grade ≤3 injuries.\textsuperscript{31}

<table>
<thead>
<tr>
<th>Source</th>
<th>Grade 1</th>
<th>Grade 2</th>
<th>Grade 3</th>
<th>Grade 4</th>
<th>Grade 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muroya 2013 (n=16)</td>
<td>0 %</td>
<td>30.4 %</td>
<td>18.4 %</td>
<td>0 %</td>
<td>--</td>
</tr>
<tr>
<td>Leeper 2014 (n=25)</td>
<td>4 %</td>
<td>16 %</td>
<td>24 %</td>
<td>56 %</td>
<td>--</td>
</tr>
</tbody>
</table>

Timing of splenic pseudoaneurysm formation varies, from 48 hours\textsuperscript{Error! Bookmark not defined.} to 1-8 hospital days after injury.\textsuperscript{30} A large prospective study found the 180-day risk of splenectomy after NOM was 3.5 %, with higher risk for higher grade injuries (6.9 % for Grades 3-5 injuries).\textsuperscript{32}

What is the risk of pseudoaneurysm bleeding?

Major risk of splenic pseudoaneurysm is hemorrhage leading to splenic rupture:

- Risk of hemorrhage from splenic pseudoaneurysm: 37 %\textsuperscript{34}
- Risk of splenic rupture due to undetected splenic pseudoaneurysm: 3-10 %\textsuperscript{35}
- Risk of mortality after splenic rupture: 10-25 %,\textsuperscript{35} as high as 90 % if left untreated\textsuperscript{34}

KMQ-9. What activity restrictions should be imposed on patients with blunt splenic injuries, in hospital and post-discharge?
RECOMMENDATIONS

F. There is no need to restrict mobilization in patients with splenic injury and early mobilization is encouraged. Patients with high risk injuries* should remain supervised until assessed as safe to ambulate independently off unit.

*CT-confirmed Grade 3-5 splenic injuries, particularly with evidence of active haemorrhage or pseudoaneurysm, anticoagulated patient, associated major injury, age ≥65 or limited physiologic reserve.

G. Post-discharge, patients with Grade 3-5 splenic injuries should avoid contact sports or vigorous activities for at least 8 weeks. Patients with Grade 3-5 splenic injuries should be re-imaged prior to resuming high-risk activities.

KNOWLEDGE SYNTHESIS

<table>
<thead>
<tr>
<th>External Recommendations</th>
<th>SAG’s Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Activity restriction may be suggested for 4-6 weeks in minor injuries and up to 2-4 months in moderate and severe injuries. [WSES: 2C]</td>
<td>New recommendation has been created, based on recent evidence (see below) and expert opinion of the SAG.</td>
</tr>
</tbody>
</table>

Additional Literature Support

**What is the risk of delayed hemorrhage in blunt splenic patients without activity restrictions?**

Several recent studies have shown no association between early mobilization with minimal bed rest and delayed splenic hemorrhage both in adult and pediatric patients with blunt splenic injuries managed via NOM.
**VII. VENOUS THROMBOEMBOLISM PROPHYLAXIS**

**KMQ-10.** What is the optimal timing for initiating deep vein thrombosis (DVT) prophylaxis in patients with blunt splenic injuries?

**RECOMMENDATIONS**

A. Pharmacologic prophylaxis to prevent venous thromboembolism (VTE) can be used for patients with isolated blunt splenic injuries without increasing the failure rate of non-operative management. Although the optimal timing of safe initiation has not been determined, deep vein thrombosis (DVT) prophylaxis may be started as soon as possible after trauma and within 12 hours for every Grade of splenic injury (e.g. 36 hours for Grade 3 injury) or sooner if hemoglobin is stable. [Adopted from EAST and WSES with modification]

B. Mechanical prophylaxis should be used in all patients with absolute contraindication to pharmacologic prophylaxis, except in patients with lower extremity trauma in which case mechanical prophylaxis is not efficacious. [Adopted from WSES with modification]

**KNOWLEDGE SYNTHESIS**

<table>
<thead>
<tr>
<th>Chemical prophylaxis</th>
<th>SAG’s Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Pharmacologic prophylaxis to prevent venous thromboembolism can be used for patients with isolated blunt splenic injuries without increasing the failure rate of non-operative management, although the optimal timing of safe initiation has not been determined. [EAST: Level 3]</td>
<td>Consolidated external recommendations. Added timing of VTE prophylaxis (i.e. within 12 hours for every injury grade) based on the expert opinion of the SAG.</td>
</tr>
<tr>
<td>• Spleen trauma without ongoing bleeding is not an absolute contraindication to LMWH-based prophylactic anticoagulation. [WSES: 2A]</td>
<td></td>
</tr>
<tr>
<td>• LMWH-based prophylactic anticoagulation should be started as soon as possible from trauma and may be safe in selected patients with blunt splenic injury undergoing NOM. [WSES: 2B]</td>
<td></td>
</tr>
<tr>
<td>• In patients with oral anticoagulants the risk-benefit balance of reversal should be individualized. [WSES: 2B]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mechanical prophylaxis</th>
<th>SAG’s Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Mechanical prophylaxis is safe and should be considered in all patients without absolute contraindication to its use. [WSES: 2A]</td>
<td>Added a contraindication for the use of mechanical prophylaxis: patients with lower extremity trauma.</td>
</tr>
</tbody>
</table>
Additional Literature Support

**What is the risk of developing thrombosis VTE prophylaxis after blunt splenic injuries?**

A prospective study (n=147) found 5% risk of developing VTE after trauma-related splenectomy.\(^{42}\)

A large retrospective study (n=6,162) found 1.97 times greater risk of VTE in splenic injury than in control, with a rate of 10.08 per 10,000 person-years (8.46 no splenectomy, 11.81 splenectomy).\(^{43}\)

A large prospective study (n=675) found increased risk for VTE with splenectomy (AOR 2.6, 95% CI 1.2 to 5.9).\(^{44}\)

**What is the incidence of hemorrhage in splenic patients with/without VTE prophylaxis?**

Several retrospective studies indicate low-molecular weight heparin (LMWH) administration does not increase the failure rate of NOM\(^{45,46}\) or increase the risk of bleeding events.\(^{47}\)
VIII. OVERWHELMING POST-SPLENECTOMY INFECTION PROPHYLAXIS

KMQ-11. Which vaccinations should be administered and when in patients with blunt splenic injuries?

RECOMMENDATIONS

A. Patients should receive immunization against the encapsulated bacteria (*S. pneumoniae*, *H. influenzae*, and *N. meningitidis*) post-splenectomy or post-proximal angioembolization. Refer to national guidelines for vaccine dosage. [Adopted from WSES with modification]

B. Revaccination against pneumococcus is recommended every 10 years.

C. Vaccination should be administered >14 days post-splenectomy/embolization. For patients where follow-up is a concern, vaccination prior to discharge is recommended. [Adopted from EAST and WSES]

D. Regarding infection prophylaxis in asplenic and hyposplenic adult patients:
   - immunization against seasonal flu is recommended;
   - malaria prophylaxis is strongly recommended for travellers;
   - antibiotic therapy should be strongly considered in the event of any sudden onset of unexplained fever, malaise, chills or other constitutional symptoms, especially when medical review is not readily accessible; and
   - primary care providers should be aware of the splenectomy/angioembolization. [Adopted from WSES]

KNOWLEDGE SYNTHESIS

<table>
<thead>
<tr>
<th>External Recommendations</th>
<th>SAG’s Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vaccination type</strong></td>
<td>Adopted and added “post-splenectomy or post-proximal angioembolization” for clarity in clinical management.</td>
</tr>
<tr>
<td>• Patients should receive immunization against the encapsulated bacteria (<em>S. pneumoniae</em>, <em>H. influenzae</em>, and <em>N. meningitidis</em>). [WSES: 1A]</td>
<td></td>
</tr>
<tr>
<td><strong>Vaccination schedule/timing</strong></td>
<td>Adopted and combined the two statements into one recommendation.</td>
</tr>
<tr>
<td>• Vaccination programs should be started no sooner than 14 days after splenectomy or spleen total vascular exclusion. [WSES: 2C]</td>
<td></td>
</tr>
<tr>
<td>• In patients discharged before 15 days after splenectomy or angioembolization, where the risk to miss vaccination is deemed high, the best choice is to vaccinate before discharge. [WSES: 1B]</td>
<td></td>
</tr>
<tr>
<td><strong>Other vaccination indications</strong></td>
<td>Adopted and combined the four statements into one recommendation for easier reading.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**External Recommendations**

<table>
<thead>
<tr>
<th>Rationale</th>
<th>SAG’s Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regarding infections prophylaxis in asplenic and hyposplenic adult and pediatric patients, immunization against seasonal flu is recommended for patients over 6 months of age. [WSES: 1C]</td>
<td></td>
</tr>
<tr>
<td>Regarding infections prophylaxis in asplenic and hyposplenic adult and pediatric patients, Malaria prophylaxis is strongly recommended for travelers. [WSES: 2C]</td>
<td></td>
</tr>
<tr>
<td>Regarding infections prophylaxis in asplenic and hyposplenic adult and pediatric patients, antibiotic therapy should be strongly considered in the event of any sudden onset of unexplained fever, malaise, chills or other constitutional symptoms, especially when medical review is not readily accessible. [WSES: 2A]</td>
<td></td>
</tr>
<tr>
<td>Regarding infections prophylaxis in asplenic and hyposplenic adult and pediatric patients, primary care providers should be aware of the splenectomy/ angioembolization. [WSES: 2C]</td>
<td></td>
</tr>
</tbody>
</table>

**Additional Literature Support**

**What is the risk of overwhelming post-splenectomy infection (OPSI) with splenectomy or splenic embolization after splenic injury?**

Risk of overwhelming post-splenectomy infection (OPSI) with splenectomy or splenic embolization ranges from 0.05-23 %,\(^2,48\) with the majority of infections occurring more than 2 years following the procedure.\(^49\)

A large retrospective study (n= 4,360) of blunt splenic trauma patients in California reported short- and long-term infectious complications by procedure\(^50\):

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Admission</th>
<th>30 days after injury</th>
<th>1 year after injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Splenic angioembolization</td>
<td>1.59 %</td>
<td>5.18 %</td>
<td>9.16 %</td>
</tr>
<tr>
<td>Splenectomy</td>
<td>1.76 %</td>
<td>4.85 %</td>
<td>8.85 %</td>
</tr>
</tbody>
</table>

A larger retrospective study of over 4000 patients with Grade 4-5 splenic injuries reported infectious complications in 11.7 % in the angioembolization group and 23.1 % in the splenectomy group.\(^48\)

Risk of mortality due to OPSI is 30-70 %, most deaths occurring within first 24 hours.\(^2\)

**What is the optimal timing of vaccination?**

All vaccines are best administered 2 weeks after surgery. If the patient is discharged earlier and there is concern that they might not return for follow-up, vaccines should be administered prior to discharge.\(^51\)

**What is the effectiveness of vaccination? What is the effectiveness of repeat vaccination?**
### Effectiveness and administration schedule of vaccination in asplenic/hyposplenic adults

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Vaccine Efficacy (VE)</th>
<th>Schedule (PHAC)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pneumococcal</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCV13</td>
<td>In healthy adults age ≥ 65 years: 75 % (95% CI, 41.4 to 90.8)(^{52})</td>
<td>1) 1 dose of PCV13 vaccine (at least 1 year after any previous dose of PPV23 vaccine)</td>
</tr>
<tr>
<td>PPV23</td>
<td>In healthy older adults VE ranges from 45-73 %,(^{53,54}) Efficacy wanes over time.(^{56})</td>
<td>2) 1 dose of PPV23 vaccine at least 8 weeks after PCV13 vaccine</td>
</tr>
<tr>
<td><strong>Repeat vaccination: PPV23</strong></td>
<td></td>
<td>3) 1 booster dose of PPV23 vaccine at least 5 years later(^{59})</td>
</tr>
<tr>
<td><strong>Meningococcal</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men-C-ACYW</td>
<td>Only data available is for Men-C-ACYW-13S-DT (Menactra). Early estimates indicate 80-85 % VE within 3-4 years of vaccination, efficacy waning over time.(^{60})</td>
<td>Age ≥11 years:</td>
</tr>
<tr>
<td></td>
<td>Age 10-23 years: 78% (95 % CI, 29 to 93 %)(^{61,62})</td>
<td>1) 2 doses of Men-C-ACYW 8 weeks apart (see notes below)</td>
</tr>
<tr>
<td>4CMenB (Bexsero)</td>
<td>No data available.</td>
<td>2) 2 doses of 4CMenB given at least 4 weeks apart (see notes below)</td>
</tr>
<tr>
<td><strong>Repeat vaccination: Men-C-ACYW</strong></td>
<td></td>
<td>3) Re-vaccination with Men-C-ACYW recommended every 5 years for those vaccinated at 7 years of age and older.(^{64})</td>
</tr>
<tr>
<td><strong>Haemophilus Influenzae Type B</strong></td>
<td></td>
<td></td>
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<tr>
<td>Hib</td>
<td>Estimated 95-100% VE in children(^{65})</td>
<td>1 dose recommended regardless of Hib immunization history (at least one year after any previous dose)(^{59})</td>
</tr>
</tbody>
</table>

**Notes:**

Men-C-ACYW vaccines are not authorized for use in adults 56 years of age and older and 4CMenB vaccine is not authorized for use in those 17 years of age and older. However, based on limited evidence and expert opinion its use is considered appropriate.\(^{64}\)

Although not recommended for routine immunization, 4CMenB vaccine should be considered for immunization of high-risk individuals (age ≥2 months) against invasive meningococcal disease caused by serogroup B strains expressing antigen covered by the vaccine.\(^{64}\)
IX. POST HOSPITAL CARE

KMQ-12. What is the optimal timing for repeat imaging after blunt splenic injury? Which imaging modality should be used to follow-up blunt splenic injury?

RECOMMENDATIONS
A. Post-discharge outpatient follow-up with imaging is recommended within 12 weeks. Patients with Grade 1-2 injuries should avoid contact sports or vigorous activities for at least 8 weeks. Grade 3-5 splenic injuries should be re-imaged at 8 weeks if the patient plans to resume high-risk activities to rule out pseudoaneurysm, subcapsular hematoma, etc..
B. Abdominal CT can be used for follow-up imaging and may allow for earlier return to sports activities. [Adapted from WSES]

KNOWLEDGE SYNTHESIS

<table>
<thead>
<tr>
<th>External Recommendations</th>
<th>SAG’s Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Doppler US and contrast-enhanced US are useful to evaluate splenic vascularization and in follow-up. [WSES: 1B]</td>
<td>SAG agreed with WSES recommendation to use Doppler ultrasound for follow-up imaging. Added further recommendation for follow-up more broadly, including timeline, imaging and return to work/sports evaluations, to offer guidance in clinical judgment based on the expert opinion of the SAG.</td>
</tr>
</tbody>
</table>

Additional Literature Support

For risk of delayed hemorrhage after non-operative management of blunt splenic injury, see page 17.

For the risk and timing of pseudoaneurysm formation after non-operative management of blunt splenic injury, see p. 24.

KMQ-13. What is the preferred management of delayed pseudoaneurysm?

RECOMMENDATIONS
C. If a new pseudoaneurysm is noted on follow-up imaging, discussion with general surgery is recommended to determine best management, e.g. serial imaging vs. embolization.
## KNOWLEDGE SYNTHESIS

<table>
<thead>
<tr>
<th>External Recommendations</th>
<th>SAG’s Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>None available</td>
<td>With lack of scientific evidence or external clinical guidance on the management of delayed splenic pseudoaneurysms, a new recommendation was developed based on the SAG’s expert opinion.</td>
</tr>
</tbody>
</table>
REFERENCES


Teichman A, Scantling D, McCracken B, Eakins J. Early mobilization of patients with non-operative liver and spleen injuries is safe and cost effective. Eur J Trauma Emerg Surg. 2017 Dec 5;


