Grading Spleen Injuries - Simplified

Spleen injury grading is not as complicated as people think! The grading system ranges from Grade I (very minor) to Grade V (shattered, devascularized).

There is one nuance that people frequently don’t appreciate: multiple injuries can increase the grade. Technically, multiple injuries advance the maximum grade by one point, up to a maximum of Grade 3. So Grade 1 + Grade 1 = Grade 2, but Grades 2+2 = 3! Weird arithmetic!

The vast majority of injuries are Grades 1 to 3, and they are actually the easiest to grade. I use this simple rule: 1 and 3, 10 and 50.

The first set of numbers indicates the depth of a laceration in centimeters.

- Grade 1 - < 1 cm laceration depth
- Grade 2 - 1-3 cm laceration depth
- Grade 3 - >3 cm laceration depth

The second set of numbers refers to size of a subcapsular hematoma in percent of the total surface area of the spleen. Hint: most of these low grades are determined by laceration depth. Very few actually have sizable subcapsular hematomas. So memorize the 1-3 rule first!

- Grade 1 - <10% subcapsular hematoma
- Grade 2 - 10-50% subcapsular hematoma
- Grade 3 - >50% subcapsular hematoma

Grades 4 and 5 use other criteria, but in general if it looks completely pulped it’s a 5, and if it’s a little less pulped, it’s a 4.

- Grade 4 - hilar injury with >25% devascularization OR contrast blush (active bleeding)
- Grade 5 - shattered spleen, or nearly complete devascularization
Splenic Vascular Blush

Contrast blush is always a concern when seen on CT of the abdomen for trauma. It can represent one of two things, and both are bad:

- Active extravasation of contrast
- Splenic pseudoaneurysm

These two clinical issues can be distinguished by looking at the location of the contrast and its persistence. A pseudoaneurysm is located within the parenchyma, and the contrast will wash away, so it will not be visible on delayed images. Contrast that extends beyond the parenchyma or persists in delayed views represents active bleeding (extravasation). In either case, the failure rate of nonoperative management exceeds 80% in adults without additional measures being taken.

Clinically, these patients usually act as if they are losing volume and require additional crystalloid and/or blood transfusion. The natural history in adults is for bleeding to continue or for the pseudoaneurysm to rupture, resulting in a quick trip to the operating room.

If vital signs can be maintained with fluids and blood, a trip to interventional radiology may solve the problem. Selective or nonselective embolization can be carried out and patients with only a few bleeding points can be spared operation. However, if multiple bleeding areas are seen, it is probably better to head to the OR for splenorrhaphy or splenectomy.

The image below shows likely areas of extravasation (arrow). They are a bit large to be pseudoaneurysms.

EAST Practice Guidelines on Spleen Injury Management

The Eastern Association for the Surgery of Trauma is in the process of updating their trauma practice guidelines for spleen injury. The first set of guidelines was introduced in 2003, and several advances in management have occurred since. Here is a summary of the current status of the guidelines.

Level I recommendations (best quality data):
- none

Level II recommendations (good data):
- Initial management of hemodynamically stable patients should be nonoperative
- Unstable patients should undergo immediate operation or angiographic embolization (my interpretation: unstable patients belong in the OR, not the angio suite!)
- Patients with peritonitis should go to the operating room
- Age, grade of injury, amount of hemoperitoneum and age are not contraindications to nonoperative management. Only hemodynamic stability matters.
- CT of the abdomen with IV contrast is the most reliable method to assess severity of spleen injury (my interpretation: in the hemodynamically stable patient)
- Angiography with embolization should be considered if a contrast blush is seen on CT, AAST grade > 3, moderate hemoperitoneum is present, or there is evidence of ongoing bleeding
- Nonoperative management should only be considered if continuous monitoring and serial exams can be carried out at your hospital, and if an operating room is immediately available if needed

Level III recommendations (weak data):
- Clinical status should dictate need and frequency of followup imaging (my interpretation: only do it if the patient condition changes for the worse)
- Contrast blush is not an absolute indication for operation or angio-embolization. Age, grade of injury and presence of hypotension need to be considered. (My interpretation: don’t operate or do angio on kids without a really good reason)
- Angio is an adjunct to nonop management in patients who are at high risk for delayed bleeding or to look for vascular injuries (pseudoaneurysms) that may lead to rupture or delayed hemorrhage

Reference: Trauma Practice Guideline Update, 24th Annual Scientific Assembly, Eastern Association for the Surgery of Trauma, January 2011.
Complications of Splenic Embolization

Angioembolization has become a common procedure that can increase the likelihood of success for nonoperative management for splenic trauma. It does have its own set of complications to be aware of, however.

The most obvious complication is **mechanical injury** to the femoral artery. This occurs in 1 to 3% of patients. It is more common in the very young (small caliber artery) and the elderly (arteries of stone). Rarely, the substance or device that is used for the embolization may migrate or end up on the wrong spot, infarcting something important.

A common issue that occurs is **infarction of portions of the spleen**. This is actually the desired effect, as it stops the bleeding. Most of the time, we are unaware of the changes that take place in the spleen post-procedure. But every once in a while we get a repeat CT scan days or weeks down the road and see some very interesting things.

The most common finding is a splenic infarct. This is an area of the spleen, sometimes wedge shaped, that does not take up contrast. This is normal. In some cases, gas bubbles are seen within the spleen parenchyma, usually within the infarcted area. In others, large areas of gas are present, and an air-fluid level may also be seen. This is definitely not normal.

On the other hand, big bubbles or air-fluid levels probably indicate a developing splenic abscess, and the patient will usually appear ill and have a high WBC count. Note the larger bubble with an air-fluid level above. Unfortunately, the only treatment for this is splenectomy. Insertion of drainage catheters does not work and the patient will only become sicker if it is attempted.

**Vaccines After Splenic Injury**

The current standard of care is to vaccinate patients after splenectomy to prevent overwhelming post-splenectomy sepsis (OPSS). The real questions are, is this reasonable and is it needed after splenorrhaphy or angioembolization, too?

The spleen was recognized as contributing to infection resistance in the early 1900s. A study on post-splenectomy sepsis that has been widely quoted was published in 1952. Unfortunately, the children involved all had hematologic disorders, so it is difficult to determine if their sepsis deaths were due to splenectomy or their underlying disease.

Reports of sepsis and death continued to accumulate in the latter half of the last century, but there was a tremendous amount of overlap in patient cases. Richardson reviewed the world literature to date and found that, as of about 2003, there were roughly 70 total cases worldwide since the beginning of time, with a death rate of about 30%. Basically, there are more published papers and reports on death from OPSS than there are actual cases!

This flawed data directed a push toward splenorrhaphy and then to nonoperative management of splenic
injury. Guidelines have been developed and revised that suggest that the following vaccines should be given to patients with splenectomy:

- **Pneumovax 23** - .5cc SQ, booster every 6 years
- **Haemophilus B conjugate** - .5cc IM, no booster
- **Meningococcal vaccine (polysaccharide or diphtheria conjugate)** - .5cc (route depends on vaccine), booster status unclear

There is no good data at all on vaccine administration after angioembolization. Animal studies suggest that at least 50% of the spleen must be perfused by the splenic artery in order to maintain immune competence. Patients who have CT or angiographic evidence that a significant portion of the spleen is not perfused should probably undergo vaccination.

Given the rarity of OPSS and the even lower probability of dying from it, a definitive study regarding the usefulness of spleen vaccine administration will never be done. So we are stuck with giving them in spleen-injured or spleen-free patients even though the usefulness can never be proven.


When To Give Spleen Vaccines

I’ve written previously on the (f)utility of giving vaccines after splenectomy for trauma (click here to read). However, it is more or less a medicolegal standard, so pretty much everyone gives them. The big question is, when?

Some centers give them immediately postop, some before hospital discharge, and some during their postop visit. Who is right? The argument is that major surgery produces some degree of immunocompromise. So if the vaccines are given too early, perhaps the antibodies will not be processed as effectively, and the response to an actual bacterial challenge might not be as good.

One prospective study randomized patients to receive their pneumococcal vaccine either 1, 7, or 14 days after surgery. IgG levels were measured before vaccination and again after 4 weeks. This study found that antibody concentrations were the same in all groups. However, functional activity of the antibodies was low in the 1 and 7 day groups, and nearly normal in the 14 day group.

Following this, a rat study looked at vaccination timing followed by exposure to pneumococcus. These animals were splenectomized, then given a real or sham vaccination at 1, 7, or 42 days. They then had pneumococcus injected into their peritoneal cavity. About 70% of all rats with sham vaccination died. Only 1.5% of the vaccinated rats died, and there were no differences based on vaccination timing.

**Bottom line:** Neither antibody titer studies nor rat studies easily translate into recommendations for treating overwhelming post-splenectomy sepsis (OPSS) in humans. And such a study can never be done because of the rarity of this condition (less than 70 cases since the beginning of time). It really boils down to your specific population, balancing your assurance that your patient will get it against the possibility that their immune system may not react to it as much as it could.

At our center, we give the vaccines as soon as possible postoperatively. This ensures that it is given, and erases any doubt of what might happen if the patient does not show up for their postop check.

References:


Solid Organ Injury Management Protocol

The following page contains the current protocol in use at Regions Hospital. Important items to note:

- **No serial hemoglobin levels.** The vital signs will change before it does.
- **Angio is needed in high grade injuries and those with blush/extravasation**
- **NPO status and bedrest periods are brief, and can probably made briefer**
- **Failure** occurs when the blood pressure drops below 80-90 systolic at any time, or if they have progression of abdominal pain. The patient must be taken to OR if this occurs.
### Vital Signs
Continuous monitoring
[no independent indication for invasive arterial monitoring]
q2º x 4, then q4º x 24 hrs

### Urine Output
Continuous monitoring x 24 hrs
Q shift

### IV Access
Ensure adequate IV access
[no independent indication for central venous access]
Ensure adequate IV access

### IV fluid
Maintenance rate
Bolus only at direction of MD
Maintenance rate
Bolus only at direction of MD

### Diet
NPO x 12 hrs, then
Diet as tolerated
NPO x 12 hrs, then
Diet as tolerated

### Lab
Hgb on admission
Hgb 4hr after admission, then
Hgb daily and at direction of MD
Hgb on admission
Hgb on Day 1 after admission, then
Hgb on physician judgment
No further labs needed

### Abdominal exam
q2º x 12 hrs by MD
4 hr after admission, then
q4º x 2, then prn
final exam before discharge

### Activity
Bedrest x 12 hrs, then
Up to chair with supervision
Bedrest overnight, then
Ambulate next day with supervision x 2, then
Activity as tolerated

### Thresholds
Call MD for SBP < 90
Call MD for Pulse > 120
Call MD for significant change in abdominal sx or exam
Call MD for SBP < 90
Call MD for Pulse > 120
Call MD for significant change in abdominal sx or exam

### Discharge criteria
Hemodynamically normal x 36 hrs
No change in abdominal sx or exam x 36 hrs as per MD judgment

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