The Trauma Professional's Blog

Trauma MedEd #65

Topic: Spleen Injury Update Subscribe: www.TraumaMedEd.com May 2019

After the initial jump to nonoperative management of spleen injury in stable patients back in the late 1980s, there has been only slow advancement since. In this issue, I'll cover what's new and different, and what might be coming in the future.

Update To Spleen Injury Scaling / Grading

Over the years, the American Association for the Surgery of Trauma (AAST) has developed and maintained a library of organ injury scales. Scaling allows us to compare apples to apples in research studies, and in many cases enables us to tailor interventions and predict outcomes. Many of the scales have been in place for decades and have not been updated. The spleen, liver, and kidney scales were introduced 25 year ago, and received their first update last December. So what's new and different?

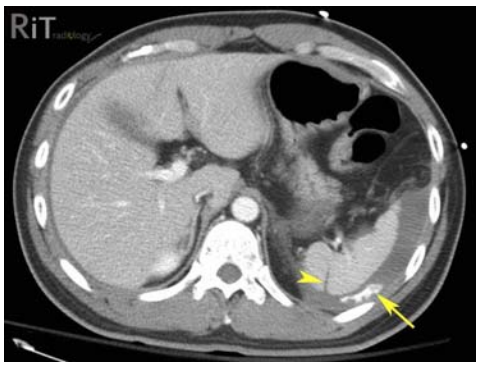
The biggest change to all three scales has been the incorporation of specific vascular injuries seen on modern-day CT scans. The original systems were solely based on anatomic appearance of the organ, since they were developed in the very early days of CT scan. Most organ injuries were found only at operation.

CT scan technology has advanced tremendously in the interim. It is now recommended that scanning for solid organ injury be conducted using dual phase (arterial and portal venous) scanning techniques. This increases study sensitivity and provides the best images for accurate diagnosis and scaling. In addition to the original anatomic criteria (which have not changed) and the new CT imaging criteria, a set of pathology criteria were also added. In the case of spleen injury, these are identical to the anatomic criteria found at operation.

The full scale can be found on the following page.

What has changed in the 2018 update to the spleen scaling guideline is the **formal addition of pseudoaneurysm and active extravasation**. These were never clearly defined in the old version. Bleeding confined within the splenic capsule (pseudoaneurysm, AV fistula) is now considered a Grade IV lesion. These are identified on CT scan by contrast collections that wash out on delayed imaging.

Extravasation that escapes the spleen is considered Grade V. This appears as a plume of contrast extending outside the body of the spleen. This image from RiT Radiology shows a spleen laceration (arr



Speaking Engagements

Pomona Valley Hospital Trauma Grand Rounds
Pomona Valley Hospital, Pomona CA
June 11, 2019

HCA Hospitals Trauma Symposium
Hyatt Regency Grand Cypress, Orlando FL
September 5, 2019

Inside This Issue

TABLE 1. Spleen Organ Injury Scale—2018 Revision

AAST Grade	AIS Severity	Imaging Criteria (CT findings)	Operative Criteria	Pathologic Criteria
I	2	– Subcapsular hematoma <10% surface area – Parenchymal laceration <1 cm depth – Capsular tear	– Subcapsular hematoma <10% surface area – Parenchymal laceration <1 cm depth – Capsular tear	– Subcapsular hematoma <10% surface area – Parenchymal laceration <1 cm depth – Capsular tear
II	2	– Subcapsular hematoma 10–50% surface area; intraparenchymal hematoma <5 cm – Parenchymal laceration 1–3 cm	– Subcapsular hematoma 10–50% surface area; intraparenchymal hematoma <5 cm – Parenchymal laceration 1–3 cm	– Subcapsular hematoma 10–50% surface area; intraparenchymal hematoma <5 cm – Parenchymal laceration 1–3 cm
III	3	– Subcapsular hematoma >50% surface area; ruptured subcapsular or intraparenchymal hematoma ≥5 cm – Parenchymal laceration >3 cm depth	– Subcapsular hematoma >50% surface area or expanding; ruptured subcapsular or intraparenchymal hematoma ≥5 cm – Parenchymal laceration >3 cm depth	– Subcapsular hematoma >50% surface area; ruptured subcapsular or intraparenchymal hematoma ≥5 cm – Parenchymal laceration >3 cm depth
IV	4	– Any injury in the presence of a splenic vascular injury or active bleeding confined within splenic capsule – Parenchymal laceration involving segmental or hilar vessels producing >25% devascularization	– Parenchymal laceration involving segmental or hilar vessels producing >25% devascularization	– Parenchymal laceration involving segmental or hilar vessels producing >25% devascularization
V	5	– Any injury in the presence of splenic vascular injury with active bleeding extending beyond the spleen into the peritoneum – Shattered spleen	– Hilar vascular injury which devascularizes the spleen – Shattered spleen	– Hilar vascular injury which devascularizes the spleen – Shattered spleen

Vascular injury is defined as a pseudoaneurysm or arteriovenous fistula and appears as a focal collection of vascular contrast that decreases in attenuation with delayed imaging. Active bleeding from a vascular injury presents as vascular contrast, focal or diffuse, that increases in size or attenuation in delayed phase. Vascular thrombosis can lead to organ infarction.

Grade based on highest grade assessment made on imaging, at operation or on pathologic specimen.

More than one grade of splenic injury may be present and should be classified by the higher grade of injury.

Advance one grade for multiple injuries up to a grade III.

owhead) and a puff of extravasation (arrow).

Why is it important to recognize these additions to spleen injury scaling? Because many hospitals (including my own) have solid organ injury protocols that distinguish between injury grades to determine actions, admitting unit, etc. Make sure that these new grades fit into your existing guidelines, or modify them so they fit your existing practice.

Overwhelming Post-Splenectomy Infection (OPSI)

Most trauma professionals have heard of OPSI, but few have ever seen it. The condition was first described in splenectomized children in 1952. Soon after, it was recognized that this infection occurred in asplenic adults as well.

OPSI is principally due to infection by encapsulated organisms, those with a special polysaccharide layer outside of the bacterial wall. This layer is only weakly immunogenic, and confers protection from the normal immune mechanisms, particularly phagocytosis. However, these bacteria are more easily identified and removed in the spleen.

OPSI may be caused by a number of organisms, the most common being Strep. pneumonia, Haemophilus influenza, and meningococcus. For this reason, the standard of care has been to administer vaccines targeting the usual organisms to patients who have lost their spleen.

How common is OPSI? A recent paper from Gernany reviewed comprehensive data from 173 intensive care units over a 2-year period. Here are some of the more interesting factoids:

- 2,859 ICU beds were screened, but the number of unique patients was not given. This is very disappointing because incidence cannot be calculated!
- 52 cases of OPSI occurred
- Only half of the patients had received vaccines
- Pneumococcus was the most common bacterium (42%). There were no H. Flu or meningococcal infections.

Papers consistently show that we are collectively not very good at ensuring that our splenectomized patients receive all their vaccines, ranging from 11-50%. And as I will discuss in the next section, the vaccination algorithm has recently gotten more complex.

Bottom line: Yes, OPSI exists and can occur in your asplenic patients. It is uncommon enough that you and your colleagues will probably never see a case. But proper vaccination remains important.

Reference: Overwhelming Postsplenectomy Infection: A Prospective Multicenter Cohort Study. Clin Infec Diseases 62:871-878, 2016.

Spleen Vaccines

Recently, I've noticed television commercials for Prevnar-13, a 13-valent pneumococcal vaccine for immunocompromised or asplenic adults. And interestingly, I noticed that the CDC has added a recommendation that these patients receive this vaccination, and then the original 23-valent vaccine (Pneumovax 23) 8 weeks later.

WTF? Patients with splenectomy (or significant angioembolization) for trauma are considered functionally asplenic. And although the data for immunization in this group is weak, giving triple vaccinations with pneumcoccal, H. flu, and meningococcal vaccines has become a standard of care.

This was difficult enough already because there was debate around the **best time to administer: during the hospital stay or several weeks later** after the immune system depression from trauma had resolved. The unfortunate truth is that many trauma patients never come back for followup, and so don't get any vaccines if they are not given during the hospital stay.

And then came the recommendation a few years ago to give a **5-year booster for the pneumococcal vaccine**. I have a hard time remembering when my last tetanus vaccine was to schedule my own booster. How can I expect my trauma patients to remember and come back for their pneumococcal vaccine booster?

So what do we do with the CDC Prevnar-13 recommendation? If we add it, it means that we give Prevnar while the patient is in the hospital, and then hope they come back 8 weeks later for their Pneumovax. And then 5 years later for the booster dose. Huh?

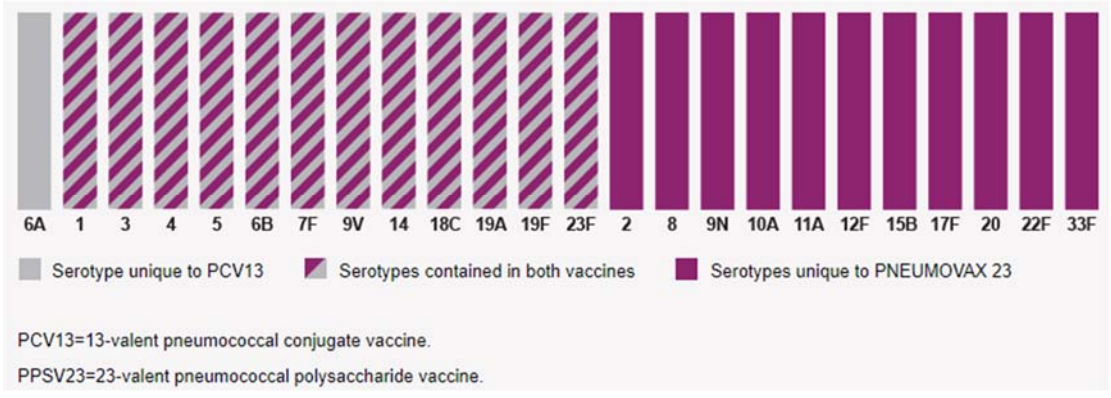
Looking at the package insert, I read that **Pneumovax 23** protects against 23 serotypes of S. Pneumo, which represent **85% of most commonly encountered strains** out there. So it's not perfect. **Prevnar-13** protects against 13 serotypes, and there is **no indication as to what percent of strains** encountered are protected against.

So I decided to dig deeper and look at the serotypes included in each vaccine. They are shown in the chart below. The 23 bars with maroon in them (solid or striped) are Pneumococcal serotypes covered by Pneumovax 23. The 13 bars containing gray are ones covered by Prevnar 13. **There is only one serotype in Prevnar 13 <u>not</u> covered by Pneumovax 23, serotype 6A.** Unfortunately, it's nearly impossible to find the prevalence of infections by serotype, and it varies geographically and over time anyway. So does coverage of a single extra serotype by Prevnar 13 justify an additional vaccination and complicated administration schedule? Hmm.

The current CDC recommendations are listed at the top of the next page. In the old days, we just gave three vaccines before they left the hospital. Then the Pneumovax 23 booster was added at 5 years. Same for the meningococcal serogroup B booster at 4 weeks. Then the meningococcal conjugate vaccine (Menactra) came along and was added (with a booster at 8 weeks). Finally, Prevnar 13 was added with its own booster, and Pneumovax 23 was delayed for 8 weeks. Oh, and don't forget the 5 year boosters for both Pneumovax 23 and the meningococcal conjugate vaccines. It has become **very complicated.**

Who needs to get these vaccines? Obviously if your patient's spleen was surgically removed, they should get it. But what about patients who underwent angioembolization? Unfortunately, the only data available is either very old or is based on antibody response to the vaccine. And antibody titers do not predict immunity to infection, so these studies are close to meaningless.

Old research showed that the spleen's immune function was preserved as long as 50% of its blood flow



Dose #1 day 1	Dose #2	
	4 weeks	8 weeks
Haemophilus b conjugate [Hib (ActHIB®)]†	n/a	n/a
Meningococcal conjugate [MenACWY-CRM (Menveo®)‡	n/a	Meningococcal conjugate (same product as Dose #1)
Meningococcal serogroup B [MenB (Bexsero®)]	Meningococcal serogroup B [MenB (Bexsero®)]	n/a
Pneumococcal conjugate 13-valent [PCV13 (Prevnar 13®])*	n/a	Pneumococcal polysaccharide 23-valent [PPSV23 (Pneumovax 23®)]

† Applies to patients that have not previously received Hib vaccine (e.g. as part of routine childhood series)
‡ Menveo preferred over Menactra if coadministered with PCV13
* Applies to those who have no hx of pneumococcal vaccines or PCV13, or those with unknown vaccination history (see appendix B)

was delivered through the splenic artery. How can you tell if half of the spleen is still functioning after splenic angioembolization? Look at the images and make an educated guess. If in doubt, vaccinate.

When is the best time to vaccinate? There has been much gnashing of teeth regarding early vs late vaccination. The arguments against early vaccination center around the typical immune suppression seen with major trauma. However, trauma patients frequently do not appear for all their followup visits and would not receive vaccines at all if they are a no-show. So I recommend vaccinating as early as possible during the hospital stay to avoid forgetting. The data recommending waiting until just before discharge are also based on antibody titers, and I don't buy it.

Bottom line: I'm not an epidemiologist. But making a set of vaccination rules more complicated for a complex population seems unwise. Especially since the added vaccine offers protection for only one more serotype of Pneumococcus.

But I can't argue with the FDA and CDC. I have no idea of the wheeling and dealing that occurred to get the new vaccine approved. All we can do is follow the recommendations the best we can, and try to remind our patients to get that Pneumovax and meningococcal conjugate booster five years down the road. Good luck with that.

Early Mobilization In Solid Organ Injury

Traditionally, most centers keep their solid organ injury patients in bed and NPO for a period of time. I suspect that they feel that walking may cause the organ to break and require operation. And if they need emergency surgery, shouldn't they have an empty stomach?

Now let's think about this. **The failure rate of nonoperative management for liver and spleen injuries in properly selected patients is somewhere between 93% and 97%.** It's been years since I've had a failure while the patient was in my hospital. And since we treat about 200 of these per year, I will be starving and restricting ambulation in a lot of patients just in case that one failure occurs.

The group at LA County – USC recently published a prospective, observational study of their 20-month experience comparing early ambulation vs delayed ambulation after liver, spleen, or kidney injury. They admitted 246 patients with these injuries, but excluded those who couldn't walk, walked out against medical advice, died, or underwent operative intervention or angiography. Here are the factoids:

- There were 36 patients in the early ambulation group (<24 hours) and 43 late ambulators (>24 hours)
- There were no complications in the early group, and three in the late group (one readmission, two developed pseudoaneurysm that required embolization)

Bottom line: This is a very small study, but it dovetails with my personal experience. We removed activity restrictions and NPO status from our solid organ protocol two years ago and have not noted any complications while in the hospital.

Reference: Safety of early ambulation following blunt abdominal solid organ injury: A prospective observational study. Am J Surg 214(3):402-406, 2017.