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Trauma Grand Rounds:
Every Tuesday morning, EXCEPT the first Tuesday of the month. Trauma Grand Rounds are held in the El Dorado Conference Room located on the 6th floor of the Neuroscience building. Anyone is invited to attend. The conference takes place from 7:30 to 8:30 am.

ATLS Provider classes 2017:
May 3-4
Aug 16-17
Dec 6-7

To register, or for any questions regarding ATLS, please Contact Dana Stout, RN at 602.406.7245.

ATCN Courses 2017:
May 3-4
Aug 16-17
Dec 6-7

For any questions regarding ATCN, please contact Jennifer Rollins, RN at 602.406.2286.

For your trauma-related educational needs, please contact Dana Stout, RN, Trauma Services Supervisor at 602.406.7245.

Trauma Quiz Answers:
#1 - False – Blunt trauma is non-penetrating trauma to the body either by impact, injury or assault.
#2 - False – an open pneumothorax is a sucking chest wound. There is an opening to the chest that allows air to enter into the chest cavity making a sucking noise. A tension pneumothorax is the buildup of air within the pleural space usually due to a lung laceration which allows air to escape into the pleural space building up pressure and causing the lung to collapse.
Open fractures are a major source of morbidity after trauma. Wounds exposed to the environment can lead to infection, chronic osteomyelitis, loss of function, and amputation.¹ The use of prophylactic antibiotics has been thought to reduce complications, justifying a short duration of therapy initiated as soon as possible in patients with open fractures. Classification of open fractures is based on the extent of injury and exposure of bone, which also dictates what specific antibiotic to use for prophylaxis. Open fractures considered to be grade I or II (clean wound, < 10 cm with minimal soft tissue injury) can be treated with a first-generation cephalosporin, such as cefazolin, which will provide gram-positive coverage. Open fractures considered to be grade III (> 10 cm with extensive soft tissue injury or a traumatic amputation) require broadened antimicrobial coverage, which has typically been achieved through the addition of an aminoglycoside, such as gentamicin. Currently, guidelines recommend targeted gram-positive coverage with a first-generation cephalosporin for 24-48 hours after wound closure in all open fractures, with the addition of gram negative coverage in grade III open fractures.²³

The addition of gram-negative coverage to grade III open fractures was derived from studies evaluating clindamycin and ciprofloxacin for prophylaxis. Researchers found infection rates in grade I and II open fractures treated with either agent were low, but infection rates increased in patients with grade III open fractures.⁴⁵ Recently, other agents with gram-negative coverage have been evaluated for grade III open fracture prophylaxis. Rodriguez et al., implemented a protocol that used cefazolin for grade I and II fractures, but replaced the cefazolin and gentamicin combination therapy for grade III fractures with ceftriaxone monotherapy. Data from 174 open fractures were analyzed and found the protocol significantly reduced aminoglycoside use without increasing skin and soft tissue infection rates, demonstrating that treatment with a single agent might provide appropriate coverage for grade III open fractures.⁶ Another study looked at the use of piperacillin/tazobactam compared to cefazolin and gentamicin in 72 patients for grade III open fracture prophylaxis. The infection rate overall at 30 days was lower in the piperacillin/tazobactam group (11.4% vs 21.6%) and similar at one year.⁷ Ceftriaxone and piperacillin/tazobactam show promising outcomes in patients with grade III open fractures, are well tolerated, and have less renal toxicities associated with them when compared to gentamicin.

Initiation and duration of therapy is also important in open fracture antibiotic prophylaxis. A retrospective study evaluated 137 patients with open fractures and found that antibiotic prophylaxis given an hour after injury was independently associated with deep infection.⁸ Antibiotics should be given as early as possible once the patient arrives at the hospital. As far as antibiotic duration, current studies recommend that closed fractures receive a single dose of an antibiotic at the time of surgical repair; therapy does not need to be continued. Open fractures require longer durations of therapy depending on the severity.
Commonly, grade I and II open fractures receive antibiotics for 24 hours and grade III open fractures receive anywhere from 48 to 72 hours therapy. Longer therapies do not reduce the risk of infection and can lead to the development of resistant organisms. A published case series reviewed 119 open fractures treated with cefazolin plus gentamicin if severe contamination was identified. Antibiotics were discontinued 2 to 3 days after the surgical procedure was completed. The researchers discovered the rate of deep wound infection or osteomyelitis to be seven percent. It is recommended that all antibiotics used for open fracture prophylaxis should be discontinued within 24 hours after wound closure.

Early administration of prophylactic antibiotics is recommended in patients with open fractures. The antibiotic selection, dose, and duration are all dependent on the open fracture classification. Other agents with gram-negative coverage, such as ceftriaxone and piperacillin/tazobactam, should be considered in patients with contraindications to cefazolin/gentamicin as outcomes appear to be similar and they are well tolerated. Attention should be placed on limiting the duration of therapy by adding stop dates to inpatient orders, with the goal to prevent overuse of antibiotics and the development of resistant organisms.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
<th>Standard Antibiotics</th>
<th>PCN Allergy Antibiotics</th>
<th>Perioperative duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade I</td>
<td>Clean wound, less than 1 cm with minimal soft tissue injury and comminution</td>
<td>Cefazolin 1-2 gm IV Q8hrs*</td>
<td>Clindamycin 900 mg IV Q8hrs</td>
<td>24 hours</td>
</tr>
<tr>
<td>Grade II</td>
<td>Wound greater than 1 cm and less than 10 cm with minimal extensive soft tissue damage, flaps, or avulsions</td>
<td>Cefazolin 1-2 gm IV Q8hrs*</td>
<td>Clindamycin 900 mg IV Q8hrs</td>
<td>24 hours</td>
</tr>
<tr>
<td>Grade III</td>
<td>Wound greater than 10 cm with extensive soft tissue injury or a traumatic amputation</td>
<td>Cefazolin 1-2 gm IV Q8hrs* + Gentamicin 5 mg/kg* IV Q24hrs** OR Piperacillin/tazobactam 3.375gm IV Q8hrs</td>
<td>Clindamycin 900 mg IV Q8hrs + Aztreonam 1 gm IV Q8hrs</td>
<td>48 – 72 hours</td>
</tr>
</tbody>
</table>

*2 g if greater than 80 kg; **Adjusted bodyweight; All antibiotics should be discontinued within 24 hours of wound closure.
Ω High-dose penicillin (e.g. Penicillin G 3-4 million units q4hrs) should be added in the presence of fecal or potential clostridial contamination (e.g., farm related injuries).
Trauma Quiz!

Question #1:
Blunt force trauma occurs when someone is impaled onto an object.
☐ True
☐ False

Question #2:
Another name for a sucking chest wound is tension pneumothorax.
☐ True
☐ False

**Answers on page 1**

References:

A male in his 20’s was the unrestrained driver involved in a motor vehicle collision. The patient was intoxicated by EMS report and he appeared to have suffered blunt abdominal trauma following a blow to his abdominal wall from the steering wheel at the time of the accident. He was taken emergently to St. Joseph’s Hospital Level I Trauma Center for evaluation. Upon arrival the patient became more lethargic with a GCS of 8 and requiring endotracheal intubation by trauma anesthesiologist. Initially he was hemodynamically stable and therefore was taken for CT imaging. A severe grade 5 liver laceration was found on CT imaging and given the extent of this injury the patient was taken emergently to the operating room for an exploratory laparotomy.

Upon opening the abdomen, the patient was found to have a large volume of blood pooling around the liver. All four quadrants of the abdomen were immediately packed with lap pads to identify areas of bleeding. The majority of blood was found to be stemming from the liver, which was essentially transected along the falciform ligament of the left lobe of the liver. In the area of transection, there were several large vessels that were ligated using a clip applier. Raw surface bleeding was electrocauterized with the Bovie device. The transection was down to the level of the inferior vena cava, which was visualized directly through the injury. The liver was packed tightly with lap pads in order the help achieve hemostasis. The abdomen was then closed in a damage control style (leaving the abdomen open with a wound vacuum device set to low suction). The patient received 10 units of packed red blood cells, 771cc cell saver, 4 units of fresh frozen plasma, 10 units of cryoprecipitate, and 1 unit of platelets during the operation. The patient was transferred to the ICU and monitored closely over the next several days. His hemoglobin remained stable without the need for any further transfusion.

On postoperative day three, he was taken back to the operating room to assess his liver. At this time, no further bleeding was identified and there were no signs of ischemia. There was a small area of bile staining noted, which lead the team to explore the portal triad (including the hepatic artery, portal vein, and common bile duct), in order to ensure there was no large bile duct injury. The gallbladder was removed at this time. Two drains were placed around the liver bed and the abdomen was then closed. Within several days, the patient was extubated and transferred out of the ICU.
On the surgical floor, the patient began having large volumes of green, bilious appearing output from his drains. His bilirubin levels were up trending. Gastroenterology was consulted for an ERCP to evaluate the bile ducts of the liver. The patient was taken for an ERCP where the gastroenterologist injected contrast across the ductal anatomy and did not find any bile leak. They placed a stent across the common bile duct to facilitate flow of bile into the intestines. The output of the drains continued to grow after this initial stent was placed, thus prompting the gastroenterology team to repeat the ERCP and exchange the stent for a smaller but wider size.
The patient progressed well after these procedures, but was having signs of infection with fever and leukocytosis several days later. He had repeat CT imaging that demonstrated a pelvic abscess. This was drained by the interventional radiology team. He progressed along and worked diligently with the physical therapy teams on a daily basis. He was subsequently discharged on post trauma day 17.

![Figure 4: CT of Abdomen with small pelvic abscess](Image)

**Traumatic Liver Injuries:**

There are several principles in dealing with traumatic liver injuries. Non-operative management is common for low grade liver lacerations in the stable patient. Non-operative management generally includes monitoring hemodynamics, trending level of hemoglobin, and serial abdominal exams. Operative management is reserved for patients with high grade injuries in the setting of hemodynamic instability. Operative techniques for repairing liver injuries generally include liver packing with second look operation, which was done in this case study. Other intraoperative measures that can be utilized include using pro-coagulant or hemostatic materials around areas of raw surface bleeding, clipping or suture hepatorrhaphy and hepatic resection in the case of uncontrolled bleeding (Townsend 2017).

The patient in the scenario described above suffered a bile leak as consequence of his liver injury, which is a complication of this disease process. This happens when, as a result of the trauma, bile flows out into the peritoneal cavity instead of down the biliary ducts into the intestines. In this scenario, the patient can then become septic and malnourished. Bile leaks are generally treated with endoscopic retrograde cholangiography (ERC) and stenting of the bile duct in order to divert flow of bile into the intestines. A retrospective review of trauma registry database was published in order to identify risk factors associated with bile leak (Yuan 2014). As they described, bile leak evaluation is not preformed universally in all blunt hepatic trauma, but only in cases of high suspicion for bile leak.

Risk factors they described include high grade injury, centrally-located liver injury (such as our case), and patients undergoing transarterial catheterization. Methods for detecting a bile leak or biloma (collection of bile fluid in the peritoneal cavity) include CT imaging and nuclear HIDA scanning. They suggested that early ERC should be considered in any patient sustaining blunt liver injury who develops abnormal fluid collection along with an elevated bilirubin to prevent further complications.

Works Cited:

Patients suffering from traumatic injury and delivered to the trauma center frequently undergo computed tomography (CT) scanning of the head, neck, chest, abdomen and pelvis. These CT scans many times reveal lesions unrelated to the traumatic injury that were pre-existing. These lesions differ in their importance, from insignificant lesions that need no follow-up; to findings that may have a greater impact on the patient’s health and will require further workup and/or monitoring by the patient’s PCP.

Studies have looked at rates of incidental findings in trauma patients and found the rate of incidental findings varied from 34% to 43% on abdominal CT scans in trauma patients. Rates of proper documentation of these findings and referral for follow-up ranges from 21% to 27% \(^{(4)}\). Thompson, Wojcik, Grant and Ko performed a retrospective chart review in their institution looking at rates of incidental findings and disclosure among discharged patient who received a CT scan in the ED. \(^{(4)}\) They looked at 600 patients, age 18 or older discharged home from an urban Level I trauma center. There were 682 CT scans among the 600 patients: 199 abdomen and pelvis scans, 405 head and 78 thoracic scans. They found a total of 348 incidental findings were documented in 228/682 (33.4%) of the scans, however only 34 (9.8%) were reported to patients in their discharge paperwork. \(^{(4)}\) This was significantly lower than the 21% to 27% found in prior studies. They felt this may have been a reflection of the difference between being discharged from the emergency room vs. being discharged from the hospital as an inpatient, when there is more time to workup these incidental findings and provide appropriate follow-up. \(^{(4)}\)

They found one of the limitations of their study was that, while finalized CT reports were used to identify the incidental findings, ED physicians many times have to rely on preliminary reports, which may not include all incidental findings. \(^{(4)}\)

Paluska, Sise, et.al, conducted a retrospective trauma registry review of 1,014 consecutive admissions from January to November 2002 at an urban Level I trauma center. \(^{(1)}\) All CT scan studies of the head, neck, chest, abdomen, pelvis and spine were reviewed for the presence of incidental findings. They excluded mucous retention cysts, chronic sinusitis (except mastoiditis), degenerative joint disease, evidence of previous operation, and age-related cerebral atrophy. They divided the incidental findings into three categories. Category 1 was incidental findings that required attention before discharge. Category 2 required follow-up with primary doctor within one to two weeks; and category three required no specific follow-up. \(^{(1)}\)

They reviewed data for 991 patients, which included 677 men and 314 women with a mean age of 36 years. Out of these patients 848 (85.6%) received at least one CT scan. Of the 848 patients who received a CT scan, 289 of them had incidental findings. Thirty-one (3.1%) had Category 1 findings, 108 had Category 2 findings, and 145 had Category 3 findings. The rate of incidental findings was higher in women and in older patients ages 40 and older. The highest number of incidental findings were found on CT scans of the abdomen and pelvis and the lowest number were found in spine scans. \(^{(1)}\) The charts of only 15 (48%) of the Category 1 findings had adequate documentation of the management of the incidental finding. \(^{(1)}\)

During this study a new practice guideline for the referral and management of incidental findings was implemented and enforced by a Nurse Practitioner. Category 1 data was reviewed for evidence of documentation of the findings and evidence of clinical management and/or referral for further workup and treatment. \(^{(1)}\) This revealed a consistently poor rate of documentation of both the incidental finding and the management or referral for these. \(^{(1)}\) Only 53% of the category 1 incidental findings had documented
treatment, follow-up and referrals, and documentation was often missing or inadequate in the discharge summaries.\(^{(1)}\)

With the increase in use of CT scan for evaluation of trauma patients the numbers of incidental findings are more likely to occur. Most of these findings will require further workup and management and should not be ignored as this can be detrimental to the patient’s health. Also without documentation and/or evidence this may represent a serious diagnosis with clinical and legal ramifications.\(^{(4)}\) The purpose of discharge paperwork is to give the patient written instructions for appropriate follow-up, thus the discharge paperwork should contain all instructions. Oral instructions that are not recorded in the discharge paperwork may represent a failure to fully disclose findings to patients.\(^{(4)}\)

There is room for improvement in the reporting and documenting of incidental findings. Some convenient methods of improving documentation of these incidental findings could be simply use of a form letter to inform the patients of incidental findings.\(^{(4)}\) The addition of an area on the Trauma Triage Summary for documentation of incidental findings that then compels the residents to report on the incidental finding as well as the management and suggested follow-up may be a solution.

The development of a structured practice management guideline was used in Paluska’s study; however there was still lack of documentation that occurred. They did note that the use of a nurse practitioner on the trauma service may be an advantage with respect to this issue. Nurse Practitioners consistently give more attention to details with the discharge instructions and follow-up. The quality of their documentation improves the completeness of discharge summaries and decreases readmissions after discharge, failures to fill prescriptions, and failures to follow-up.\(^{(1)}\)

References:


Incidental findings of bilateral Adrenal nodules on CT scan of Abdomen and Pelvis.