Eastern Association for the Surgery of Trauma

28th Annual Scientific Assembly

Sunrise Session 12
Disease Grading Systems in Emergency General Surgery

January 16, 2015
Disney’s Contemporary Resort
Lake Buena Vista, Florida
Overview

- Background of grading systems
- AAST methodology
- Sample case discussion
  - Appendicitis
  - Diverticulitis
  - Peptic ulcer disease
- Controversies in disease grading

The problem

- EGS needs outcome data to further define it as a specialty
- Outcome data will require standardization of the disease
- Current grading systems do not address the acute disease process or do not fit into a standard nomenclature
What is the goal of grading system?

- Clinical tool to guide therapy
- Research tool
- Create a language that everyone can share

Requirements of a grading system

- Must be universally applicable
- Must be simple  
  – May be radiologist or surgeon-dependent
- Fit the anatomic requirements, increasing severity

Essentials of a EGS Grading System
Essentials of a EGS Grading System

- Standard progression from minimal disease to fulminant disease
- Granularity among levels of disease
- Ability to classify non-operative cases

Process of creating a AAST system

- Wanted a grade that just described the mechanical disease

What to partner with a mechanical grade

- Co-morbidities
- Charleston
- Physiology
- Apache
- MODS?
Basic Format Chosen for mechanical disease grade

<table>
<thead>
<tr>
<th>Grade</th>
<th>Disease Grade</th>
<th>Clinical and/or Operative criteria</th>
<th>Imaging and/or endoscopic criteria</th>
<th>Pathologic criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Local disease</td>
<td>Confined to the organ</td>
<td>Minimal abnormality</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Local disease</td>
<td>Confined to the organ</td>
<td>Severe abnormality</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Beyond the organ</td>
<td>Locally advanced only</td>
<td>Locally advanced</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>Beyond the organ</td>
<td>Widespread involvement</td>
<td>Widespread involvement</td>
<td></td>
</tr>
</tbody>
</table>

Diverticulitis - Hinchey

- The Hinchey classification - proposed by Hinchey et al. in 1978[1] classifies a colonic perforation due to diverticular disease.
  - Hinchey I - localised abscess (para-colonic)
    - Hinchey II - pelvic abscess
  - Hinchey III - purulent peritonitis (the presence of pus in the abdominal cavity)
    - Hinchey IV - feculent peritonitis.

Appendicitis

- Case study
## Appendicitis

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>Clinical Criteria</th>
<th>Imaging Criteria</th>
<th>Operative Criteria</th>
<th>Pathologic Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Acutely inflamed</td>
<td>Pain, elevated WBC and RLQ tenderness</td>
<td>Inflammatory changes localized to appendix +/- appendiceal dilation +/- contrast non-filling</td>
<td>Acutely inflamed</td>
<td>Presence of neutrophils at the base of crypts, submucosa +/- in muscular wall</td>
</tr>
<tr>
<td>II</td>
<td>Gangrenous appendix</td>
<td>Pain, elevated WBC and RLQ tenderness</td>
<td>Appendiceal wall necrosis with contrast non-enhancement +/- air in appendiceal wall</td>
<td>Gangrenous appendix</td>
<td>Mucosa and muscular wall digestion; not identifiable on H&amp;E</td>
</tr>
<tr>
<td>III</td>
<td>Perforated appendix</td>
<td>Pain, elevated WBC and RLQ tenderness</td>
<td>Above with local periappendiceal fluid +/- contrast extravasation</td>
<td>Perforated appendix</td>
<td>Gross perforation or focal dissolution of muscular wall</td>
</tr>
<tr>
<td>IV</td>
<td>Perforated appendix with phlegmon or abscess</td>
<td>Pain, elevated WBC and RLQ tenderness, may have palpable mass, duration of history &gt;X days</td>
<td>Regional soft tissue inflammatory changes, phlegmon or abscess</td>
<td>Above with evidence of local contamination</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>Perforated appendix with generalized peritonitis</td>
<td>Generalized peritonitis</td>
<td>Diffuse abdominal or pelvic inflammatory changes +/- free intra-peritoneal fluid or air</td>
<td>Above with generalized purulent contamination away from appendix</td>
<td>N/A</td>
</tr>
</tbody>
</table>

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**Anatomic description**

**Imaging**
Discussion

• Disease grade?

Perforated Gastric Ulcer

• Case study

Anatomic description
Perforated Peptic Ulcer

<table>
<thead>
<tr>
<th>Grade</th>
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<th>Pathologic Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Micro-perforation without peritonitis</td>
<td>Discomfort in the epigastric region</td>
<td>Extraluminal gas with no associated inflammatory changes</td>
<td>Preservation of normal anatomy with dissection required to identify the perforation</td>
<td>Perforation with minimal bowel wall inflammation</td>
</tr>
<tr>
<td>II</td>
<td>Contained perforation with localized peritonitis</td>
<td>Tenderness confined to the right upper quadrant</td>
<td>Extraluminal gas contained in a walled off collection or the retroperitoneum</td>
<td>Presence of inflammation and stigmata of perforation with contained collection</td>
<td>Perforation with bowel wall inflammation</td>
</tr>
<tr>
<td>III</td>
<td>Perforation with localized peritonitis and localized fluid collection in lesser sac or right upper quadrant</td>
<td>Tenderness confined to the right upper quadrant</td>
<td>Perforation with associated collection that is not contained in an anatomic space or abscess but not disseminated</td>
<td>Inflammation and contamination of peritoneal cavity confined to the right upper quadrant</td>
<td>Perforation with bowel wall inflammation</td>
</tr>
<tr>
<td>IV</td>
<td>Free perforation with peritonitis</td>
<td>Diffuse peritonitis</td>
<td>Perforation with disseminated air and fluid</td>
<td>Perforation with disseminated succus or purulent peritonitis</td>
<td>Perforation with bowel wall inflammation</td>
</tr>
<tr>
<td>V</td>
<td>Perforation with duodenal destruction ± penetration into adjacent organs and generalized peritonitis</td>
<td>Diffuse peritonitis</td>
<td>Perforation with disseminated air and fluid</td>
<td>Perforation with disseminated succus or purulent peritonitis and erosion into adjacent structures</td>
<td>Destructive erosion of involved structures</td>
</tr>
</tbody>
</table>

Discussion

• Disease grade?
Diverticulitis

• Case study

Anatomic description

Imaging
Diverticulitis

<table>
<thead>
<tr>
<th>Grade</th>
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<th>Operative Criteria</th>
<th>Pathologic Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Colonic inflammation</td>
<td>Pain</td>
<td>Elevated WBC count</td>
<td>Minimal/No tenderness</td>
<td>Mesenteric stranding</td>
</tr>
<tr>
<td>II</td>
<td>Colon microperforation or pericolic phlegmon without abscess</td>
<td>Local tenderness (single or multiple areas)</td>
<td>No peritonitis</td>
<td>Pericolic phlegmon</td>
<td>Foci of air (single or multiple locations)</td>
</tr>
<tr>
<td>III</td>
<td>Localized pericolic abscess</td>
<td>Localized peritonitis</td>
<td>Pericolic abscess</td>
<td>Pericolic abscess</td>
<td>Perforation</td>
</tr>
<tr>
<td>IV</td>
<td>Distant and/or multiple abscesses</td>
<td>Localized peritonitis at multiple locations</td>
<td>Abscess/phlegmon away from the colon</td>
<td>Abscess/phlegmon away from the colon</td>
<td>N/A</td>
</tr>
<tr>
<td>V</td>
<td>Free colonic perforation with generalized peritonitis</td>
<td>Generalized peritonitis</td>
<td>Free air and free fluid</td>
<td>Perforation with generalized fecal and purulent contamination</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Discussion

• Disease grade?

Controversies in disease scoring
Validation of the Grading System

- Inter-observer reliability
- Dependent on radiographic, anatomic, and pathologic analysis
- Analogous to AAST Organ Injury Scale
  – Basis for multiple future studies

ICD Mapping

- Would be necessary if automated coding were to occur
- Needs the ICD codes to deliver enough granularity to place the patients into mechanical grades
- There exists the ability to petition ICD-10 codes to refine the code definitions.

### Diverticulitis

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>Clinical Criteria</th>
<th>Imaging Criteria</th>
<th>Operative Criteria</th>
<th>Pathologic Criteria</th>
<th>ICD-9-CM Codes</th>
<th>ICD-10-CM Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Colonic inflammation</td>
<td>Pain</td>
<td>Elevated WBC count</td>
<td>Minimal/No tenderness</td>
<td>Mesenteric stranding</td>
<td>Colon wall thickening</td>
<td>562.11 or 562.13</td>
</tr>
<tr>
<td>II</td>
<td>Colon microperforation or pericolic phlegmon without abscess</td>
<td>Local tenderness (single or multiple areas)</td>
<td>No peritonitis</td>
<td>Pericolic phlegmon</td>
<td>Foci of air (single or multiple locations)</td>
<td>No abscess</td>
<td>562.11 or 562.13</td>
</tr>
<tr>
<td>III</td>
<td>Localized pericolic abscess</td>
<td>Localized peritonitis</td>
<td>Pericolic abscess</td>
<td>Pericolic abscess</td>
<td>Perforation (562.11 or 562.13) and (567.22 or 569.5)</td>
<td>Free air and free fluid</td>
<td>K57.20 or K57.21 or K57.40 or K57.41 or K57.80 or K57.81</td>
</tr>
<tr>
<td>IV</td>
<td>Distant and/or multiple abscesses</td>
<td>Localized peritonitis at multiple locations</td>
<td>Abscess/phlegmon away from the colon</td>
<td>Abscess/phlegmon away from the colon</td>
<td>N/A (562.11 or 562.13) and (567.21 or 567.29 or 567.38)</td>
<td>Free air and free fluid</td>
<td>K57.20 or K57.21 or K57.40 or K57.41 or K57.80 or K57.81</td>
</tr>
<tr>
<td>V</td>
<td>Free colonic perforation with generalized peritonitis</td>
<td>Generalized peritonitis</td>
<td>Generalized peritonitis</td>
<td>Generalized fecal and purulent contamination</td>
<td>N/A (562.11 or 562.13) and (567.21 or 567.29)</td>
<td>Free air and free fluid</td>
<td>K57.20 or K57.21 or K57.40 or K57.41 or K57.80 or K57.81</td>
</tr>
</tbody>
</table>
Applicable ICD codes

ICD-9-CM code descriptions:
562.11 Diverticulitis of colon (without mention of hemorrhage)
562.13 Diverticulitis of colon with hemorrhage
567.21 Peritonitis (acute) generalized
567.22 Peritoneal abscess
567.29 Other suppurative peritonitis
567.31 Psoas muscle abscess

ICD-10-CM code descriptions:
K57.20 Diverticulitis of large intestine with perforation and abscess without bleeding
K57.21 Diverticulitis of large intestine with perforation and abscess with bleeding
K57.32 Diverticulitis of small intestine without perforation or abscess without bleeding
K57.33 Diverticulitis of small intestine without perforation or abscess with bleeding
K57.40 Diverticulitis of both small and large intestine with perforation and abscess without bleeding
K57.41 Diverticulitis of both small and large intestine with perforation and abscess with bleeding
K57.52 Diverticulitis of both small and large intestine without perforation or abscess without bleeding
K57.53 Diverticulitis of both small and large intestine without perforation or abscess with bleeding
K57.80 Diverticulitis of intestine, part unspecified, with perforation and abscess without bleeding
K57.81 Diverticulitis of intestine, part unspecified, with perforation and abscess with bleeding
K57.92 Diverticulitis of intestine, part unspecified, without perforation or abscess without bleeding
K57.93 Diverticulitis of intestine, part unspecified, without perforation or abscess with bleeding

Where to find this data?

• UHC
• NSQIP
  – Only operative cases are included
  – Very few emergent cases are included

Severity estimation with UHC, NIS, NSQIP, NHSN
UHC and NIS: Quantification of EGS and markers of severity

UHC background
- Quality tool started in 1984
- Most data avail from 2008-present
- 116 academic hospitals and 276 affiliates
- Intended to be used a comparison tool
- Drilling down
  - Individual patients
    - By diagnosis, procedure, complication, etc.
  - Individual practitioner
  - Individual institution
- Differing stratification schemes

NIS background
- Data from 8M admits, 20% of admissions
- States participating in HCUP (96% of population)
- Data available from 1988-present (2010 most recent)
  - Primary and secondary diagnoses
  - Primary and secondary procedures
  - Admission and discharge status
  - Patient demographics (e.g., gender, age, race, median income for ZIP Code)
  - Expected payment source
  - Total charges
  - Length of stay
  - Hospital characteristics (e.g., ownership, size, teaching status)
UHC severity modeling

- All patient-related diagnosis-related grouping
- Categorical modeling severity, risk of mortality
  - Mild
  - Moderate
  - Major
  - Extreme
- Modeling = MS-DRG in academic centers
- Bias
  - Omitted risk factors
  - Biased reporting of risk factors (over vs under-reporting)
  - Statistical bias
    - May over- or underfit depending on factor reporting per hospital
- Recalibrated for each fiscal year

NIS severity modeling

- APR-DRG like UHC
- 30 AHRQ comorbidity indices
- Disease staging
  - Stage 1: no complications or minimal severity
  - Stage 2: single organ/system, increased risk of compl
  - Stage 3: multi-site involvement, systemic, poor px
  - Stage 4: death
- Disease LOS, mortality, resource demand scale
  - Very low (<5% of patients)
  - Low (5-25% of patients)
  - Medium (25-75% of patients)
  - High (75-95% of patients)
  - Very high (>95% of patients)

Pros/cons

- UHC
  - Pros
    - How are we doing compared to our peers?
    - How is XXX surgeon performing?
    - Outcome questions by diagnosis, DRG, clinical category, etc.
    - Can access the entire dataset at the patient level
  - Cons
    - Doesn’t answer the question of “What is EGS”
    - Dependent on ongoing recruitment, incomplete populations
    - Doesn’t provide hospital characteristics
    - Limited stratification power
Pros/cons

- **NIS**
  - **Pros**
    - More complete dataset
    - 20% sample of majority of admits in US
    - OR utilization vs non OR procedures
    - More complete population, date range
  - **Cons**
    - Severity of illness dep on diagnoses > physiology
    - Massive dataset (~9GB/year)
    - Cost ($50 per year for students, $350 for faculty)
    - In-hospital outcome

NSQIP Purpose and Structure

- Semiannual report of risk-adjusted morbidity and mortality
- Interim reports: ongoing assessment/comparison
- 1680 cases per year; ~100 variables collected
  - 100% colectomy, proctectomy, ventral hernia repair
  - General Surgery and Vascular random sample
- Inclusion / Exclusion Criteria
  - Service
  - CPT code
  - Trauma / Transplant excluded during that admission

Data Collection

**Preoperative data**
- Demographics
- Clinical laboratory variables

**Intraoperative data**
- Surgical Profile
- Clinical variables and complications

**Postoperative data**
- 30-day outcomes (inpatient and outpatient)
- Complications and discharge variables
Risk-Adjustment

Mortality
- ASA Class
- CPT Code
- Albumin
- Age
- Sepsis
- Disseminated Cancer
- Functional Status
- Emergency Surgery

Morbidity
- CPT Code
- ASA
- Albumin
- Sepsis
- Dyspnea
- Work RVU
- > Creatinine
- Emergency Surgery

SSI
- CPT Code
- BMI
- Inpatient
- ASA
- Smoker
- Wound Class
- Sepsis
- Sodium < 135

Data Collection
- Entire chart is reviewed for risk and occurrence variables
- Follow-up continues for 30 days postop
- If documentation is not available in the VUMC record, the patient is contacted directly
- If the patient’s condition is not complete up to 30 days, the record is considered incomplete
Data Collection

- Entire chart is reviewed for risk and occurrence variables
- Follow-up continues for 30 days postop
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Preoperative Risk Factors

- BMI
- Diabetes
- Smoking
- Dyspnea
- Functional status
- Vent dependence
- COPD
- Ascites
- CHF
- Hypertension
- Renal Failure with or without dialysis requirement
- Disseminated Cancer
- Open wound
- Steroid / immunosuppression use
- > 10% loss of body weight
- Bleeding disorders
- Preop transfusion
- SIRS / Sepsis / septic shock
- Laboratory testing

Colectomy only: mechanical bowel prep, oral antibiotic prep, chemotherapy w/n 90 days

Preoperative Risk Factors

Disseminated Cancer

Enter "Yes" if the patient has a primary cancer that has metastasized to a major organ (i.e. AJCC Stage IV), and the patient meets at least one of the following criteria:

- the patient has received active treatment for the cancer within one year of their ACS NSQIP assessed procedure surgery date. If the ACS NSQIP assessed surgical procedure is the treatment for the metastatic cancer, assign disseminated cancer to the case.
- the extent of disease is first appreciated at the time of the surgical procedure in question.
- the patient has elected not to receive treatment for the metastatic disease.
- the patient’s metastatic cancer has been deemed untreatable.
Preoperative Risk Factors

Functional Status

- **Independent**: The patient does not require assistance from another person for any activities of daily living. This includes a person who is able to function independently with prosthetics, equipment, or devices.
- **Partially dependent**: The patient requires some assistance from another person for activities of daily living. This includes a person who utilizes prosthetics, equipment, or devices but still requires some assistance from another person for ADLs.
- **Totally dependent**: The patient requires total assistance for all activities of daily living.

Intraoperative Variables

- Emergency Case
- Wound classification
- Surgical wound closure
- ASA Class
- Operative start / finish times
- Other / concurrent procedures
- Colectomy only
  - Primary indication
  - Operative approach
  - Positive margins
  - Pathologic staging

Intraoperative Variables

Emergency Case: An emergency case is usually performed within a short interval of time between patient diagnosis or the onset of related preoperative symptomatology. It is implied that the patient’s well-being and outcome is potentially threatened by unnecessary delay and the patient’s status could deteriorate unpredictably or rapidly.

The emergency case variable distinguishes between urgent/semi-elective/elective cases and true emergent surgeries. Urgent/semi-elective cases are not considered emergencies. Assign 'YES' if the surgeon and/or anesthesiologist report the case as emergent.
Postoperative Occurrences

- Superficial, Deep, and Organ/Space SSI
- Wound disruption
- Pneumonia
- Unplanned intubation
- On ventilator > 48 hours
- Urinary Tract Infection
- Progressive Renal Insufficiency
- Acute Renal Failure
- Stroke / CVA

Colectomy only: Anastomotic leak, prolonged ileus

- Cardiac arrest requiring CPR
- Myocardial infarction
- Transfusion within 72 hours
- Venous thromboembolism
- Sepsis / Septic Shock
- Death
- Readmission

NSQIP Mortality

- All cause 30-day mortality
- Unlike institutional mortality data, post-discharge deaths are captured
  - 37 deaths / 1603 patients = 2.31%
  - 14 deaths were post discharge

<table>
<thead>
<tr>
<th>Procedure Selection</th>
<th>ICD-9 Procedure Code from hospital billing; All surgical services included. May be principal or secondary procedure</th>
<th>CPT Codes: OR Schedule, review of operative note, surgeon billing. General and vascular surgery patients reviewed for inclusion. Ostomies and takedowns are not in the Colectomy category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exclusion Criteria</td>
<td>Patients with wound left open at the index procedure <em>Trauma and Transplant patients Patients with proc w/in 30 days prior to index operation Wound closure noted; no exclusion for wounds left open</em></td>
<td></td>
</tr>
<tr>
<td>Surveillance Period</td>
<td>30 days for most with exception of 365 days if implant placed 30 days for all procedures</td>
<td></td>
</tr>
<tr>
<td>Multiple Procedures</td>
<td>Infection attributed to most likely site prioritized by risk Primary procedure is CPT Code with highest work RVU SSI is not assigned to specific procedure</td>
<td></td>
</tr>
<tr>
<td>Risk Adjustment</td>
<td>Stratified by risk index that incorporates the following: Duration of operation Wound class ASA classification New regression model risk stratification implemented in Jan 12 Odds Ratio: multivariate regression analysis models every six months; significant factors include Wound class Body mass index Preoperative sepsis ASA classification Patient age Emergent operation</td>
<td></td>
</tr>
</tbody>
</table>
Potential Opportunities for Standardization

• Examine best practices and standardize
  – Bowel isolation training
  – Bowel prep and oral antimicrobial prophylaxis
  – Maintenance of normothermia
  – Bowel isolation/technique
  – ? Prevent hypoxia