RISK STRATIFICATION IN CIRRHOSIS: FOCUS ON UMBILICAL HERNIA

Sam Hawkins MD  PGY5
PATIENT PRESENTATION

- 73M w/ Hep B Cirrhosis, HTN, DM II
  - Liver disease followed at OSH x2 years (when moved from China), on tenofivir, lasix
- Known umbilical hernia, acute onset of pain at hernia site x1d
- Constipation, obstipation, nausea & vomiting x1d
Patient Presentation

- 98.5  95  143/78  16  100%RA
- NAD, AAOx3
- Abdomen distended with fluid wave
- Bilateral inguinal hernias, fluid filled
PATIENT PRESENTATION

- CBC: 5.1/12.2/37.1/53
- BMP: 136/4.4/103/27/34/1.3/224 8.6/2.2/4.0
- LFTs: 8.6/2.5/51/50/88/2.7
- Coags: 16.3/27.8/1.8
## Child-Pugh Score for Cirrhosis Mortality

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bilirubin</strong></td>
<td></td>
</tr>
<tr>
<td>&lt;2 mg/dL</td>
<td>+1</td>
</tr>
<tr>
<td>2.3 mg/dL (34-50 µmol/L)</td>
<td>+2</td>
</tr>
<tr>
<td>&gt;3 mg/dL (&gt;50 µmol/L)</td>
<td>+3</td>
</tr>
<tr>
<td><strong>Albumin</strong></td>
<td></td>
</tr>
<tr>
<td>&gt;3.5 g/dL (&gt;35 g/L)</td>
<td>+1</td>
</tr>
<tr>
<td>2.8-3.5 g/dL (28-35 g/L)</td>
<td>+2</td>
</tr>
<tr>
<td>&lt;2.8 g/dL</td>
<td>+3</td>
</tr>
<tr>
<td><strong>INR</strong></td>
<td></td>
</tr>
<tr>
<td>&lt;1.7</td>
<td>+1</td>
</tr>
<tr>
<td>1.7-2.2</td>
<td>+2</td>
</tr>
<tr>
<td>&gt;2.2</td>
<td>+3</td>
</tr>
<tr>
<td><strong>Ascites</strong></td>
<td></td>
</tr>
<tr>
<td>No Ascites</td>
<td>+1</td>
</tr>
<tr>
<td>Ascites, Medically Controlled</td>
<td>+2</td>
</tr>
<tr>
<td>Ascites, Poorly Controlled</td>
<td>+3</td>
</tr>
<tr>
<td><strong>Encephalopathy</strong></td>
<td></td>
</tr>
<tr>
<td>No Encephalopathy</td>
<td>+1</td>
</tr>
<tr>
<td>Encephalopathy, Medically Controlled</td>
<td>+2</td>
</tr>
<tr>
<td>Encephalopathy, Poorly Controlled</td>
<td>+3</td>
</tr>
</tbody>
</table>

**11 points**  
Child-Pugh Score: Child Class C.  
Life Expectancy: 1-3 years.  
Abdominal surgery peri-operative mortality: 82%.
### MELD Score (Model For End-Stage Liver Disease) (12 and older)

<table>
<thead>
<tr>
<th>Factor</th>
<th>Value</th>
<th>Points</th>
<th>Estimated 3-Month Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dialysis at least twice in the past week</td>
<td></td>
<td></td>
<td>19 points</td>
</tr>
<tr>
<td>Creatinine</td>
<td>1.3 mg/dL</td>
<td></td>
<td>19.6%</td>
</tr>
<tr>
<td>Bilirubin</td>
<td>2.7 mg/dL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INR</td>
<td>1.8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PATIENT PRESENTATION

- Discussion with patient and son at bedside including significant risks of surgery...
  - DNR/DNI status
  - Refusal of surgery
- Admitted
- NGT/NPO
- Serial abdominal exams
PATIENT PRESENTATION

- HD 1-3 pt did not improve and hernia became increasingly discolored, tense, and painful
- Patient expressed desire for surgery at night, added on for following day
- 97.8  83  18  134/78  99%
- Creatinine  1.3 → 1.0
- Bilirubin  2.7 → 4.1
- INR  1.8 → 2.3
- Pt became encephalopathic
- Ammonia 160
- Son elected to consent to surgery the following morning, taken to surgery emergently
OPERATIVE COURSE

- Opened hernia sac → immediate release of large ascites and obvious necrotic small bowel
- Hernia defect 1cm, opened to deliver dilated and collapsed small bowel, viable in both directions from defect (opened to approx 6 cm)
- Removed ascites (total 8L by end of case)
- Resected 25cm small bowel → side-to-side stapled anastomosis
- Closed defect w/ running #1 prolene
- Skin left open and packed
- Operative time: 2h
- Given 4u FFP, 1000 crystalloid
- EBL 100, UOP 300
- Taken to SICU intubated
POSTOPERATIVE COURSE - OVERVIEW

- POD 0-2: critical
- POD 3-11: progression to multi-organ failure
- POD 12: family elected against escalation of care and made DNR status, to maintain abx and ETT, institute comfort care
- POD 15: expired in PM
POSTOPERATIVE COURSE - SYSTEMS

- **N:** non-responsive off sedation → lactulose → POD 4 responsive with agitation → POD 10 increasingly obtunded off sedation until expiration
- **C:** initially NT/NTC → POD 4 hypertensive with new onset afib w/ RVR → amiodarone gtt + metoprolol → POD 10 switched to metoprolol, rate maintained in afib
- **P/ID:** initially kept intubated → POD 3 failed SBT → CXR after fever demonstrates bilateral infiltrates → resp cx w/ MSSA and enterobacter → abx initiated and maintained until expiration → multiple self-extubations with successful re-intubations
**Postoperative Course - Systems**

- **Heme**
  - Initially on HSQ for DVT ppx
  - Vitamin K
  - POD 8 pt had coffee-ground NGT aspirate and dropped Hct 30 → 22. INR 3.1, platelets 38 (ranged throughout admission 20-50)
  - Transfused PRBC, platelets, FFP, HSQ d/c’d
  - Intermittent coffee-ground emesis, no additional drop in Hct or PRBC transfusions
POSTOPERATIVE COURSE - SYSTEMS

Renal/Fluids
- 8L ascites drained intraop → 1u albumin in PACU
- Normotensive over POD 0-3, became hypertensive controlled with metoprolol until expiration
- BUN/Crt 40/1.2 → BUN increased over 10 days to 120s, Crt stable 1.2-1.5 until POD 7, increased to 2, 3, 5
- Na peaked at 154 on POD 4, NS initially to ½ NS @ maintenance rate
- Lasix IV and spironolactone NG for ascites, albumin given daily with lasix, no return of ascitic distension
POSTOPERATIVE COURSE - SYSTEMS

- GI
  - Trickle feeds from POD1 advanced to goal feeds with hepatic formula
  - Bilirubin post-op stable at 4-5 until POD 8 increased to 10 then 20
OVERVIEW

- Pathophysiology of Cirrhosis
- Pre-operative and Post-operative considerations
- Risk stratification
  - Patient specific factors
    - Contraindications to surgery
  - Scoring systems
    - CTP, MELD, is there a right score to use?
  - Surgery specific factors
    - Umbilical hernia as special case?
PATHWAY

Pt in need of non-hepatic surgery

H&P

No evidence of liver disease or cirrhosis

Continue pre-operative assessment

GET SURGERY

Suspicious for liver disease

Characterize
• LFTs
• Serology
• Imaging

Risk Stratification
• Risk Score
• Other Patient Factors
• Surgery Type

Unacceptable Risk

Pursue alternative therapy

Acceptable Risk

Optimize

SURGERY

Manage post-operative care
PATHWAY

Pt in need of non-hepatic surgery

H&P

No evidence of liver disease or cirrhosis

Continue pre-operative assessment

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SURGERY

Manage post-operative care

www.downstatesurgery.org
PATHOPHYSIOLOGY OF CIRRHOSIS

Portal Hypertension
- Hemodynamics – circulating volume and pressure
- Cardiac function – hyperdynamism
- Renal function
- Ascites

Liver Function
- Synthetic
  - Coagulation
- Metabolic
  - Toxins, pharmacology
  - Nutrition
  - Infectious disease
Normal System
Cirrhosis

1. Intrahepatic – NO decreased, TXA increased (+ Scarification)
Cirrhosis

1. Intrahepatic – NO decreased, TXA increased (+ Scarification)
2. Collateral flow
3. Splanchnic circulation becomes vasodilatory to compensate (with decrease in systemic)
Principal effects:

- Hyperdynamic cardiac function with little reserve
- Maximized hepatic circulation with little reserve
- Decreased renal blood flow
Effects on Kidney?

- Decreased blood flow
- Activation of Renin-Angiotensin-Aldosterone
- Non-osmotic release of vasopressin
Effects on Kidney?

- Decreased blood flow
- Activation of Renin-Angiotensin-Aldosterone
- Non-osmotic release of vasopressin

→ renal hypoperfusion
→ sodium retention (fluid overload)
→ free-water retention in excess of sodium retention (hyponatremia)
Compensation vs Decomposition
PATHOPHYSIOLOGY OF CIRRHOSIS

- Ascites
  - 10% in cirrhosis
  - 60% 3 year survival after onset
  - Hemodynamic consequences
    - Increased splanchnic flow + increased portal pressure
      - Capillary permeability increases
    - Hypoalbuminemia
OPTIMIZATION BY SYSTEMS

- Cardiac – Hyper-dynamism
  - Pre-operative
    - Cardiac assessment
    - Awareness of lack of reserve
  - Post-operative
    - Avoid inotropic agents
OPTIMIZATION BY SYSTEMS

Renal

- Pre-operative
  - Renal function studies
  - Assessment for hepatorenal syndrome
  - Judicious use of diuretics for ascites and lactulose for encephalopathy (volume)
  - Albumin vs crystalloid

- Post-operative
  - Monitoring for HRS
  - Albumin vs crystalloid
OPTIMIZATION BY SYSTEMS

- Hepatorenal Syndrome
  - Overwhelming activation of renin-angiotensin-aldosterone system
  - Difficult to reverse
  - High mortality

Box 1
Diagnostic criteria for hepatorenal syndrome

The diagnosis of hepatorenal syndrome requires all of the following:
I. Cirrhosis with ascites
II. Serum creatinine >1.5 mg/dL
III. No improvement of serum creatinine (to ≤ 1.5 mg/dL) after at least 2 days with diuretic withdrawal and volume expansion with albumin (1 g/kg body weight up to maximum 100 g/d)
IV. Absence of shock
V. No current or recent treatment with nephrotoxic drugs
VI. Absence of parenchymal kidney disease as indicated by proteinuria >500 mg/dL, microhematuria (>50 red blood cells per high-powered field), and/or abnormal renal ultrasonography.

OPTIMIZATION BY SYSTEMS

Hepatorenal Syndrome

- Treatment
  - Terlipressin – splanchnic vasoconstriction
  - Albumin+octreotide+midodrine
  - RRT - failure
OPTIMIZATION BY SYSTEMS

- **Ascites**
  - Pre-operative
    - Diuretic therapy- spironolactone and furosemide
    - Large Volume Paracentesis (LVP)
    - Albumin administration with LVP
    - Screening for SBP
  - Post-operative
    - Same

- **Paracentesis Induced Circulatory Dysfunction**
  - Fluid shift vs vasodilation
  - Hypovolemia and R-A-A activation
  - Volume expansion >5L w/ albumin
OPTIMIZATION BY SYSTEMS

- Neurologic
  - Pre-operative
    - Consider diagnosis of hepatic encephalopathy
    - Lactulose, rifaximin, serial ammonia measurements unhelpful
    - Avoidance of sedation
  - Post-operative
    - Same
OPTIMIZATION BY SYSTEMS

- Coagulation
- Synthetic (factors) + consumptive (platelets)
  - Pre-operative
    - Vitamin K
    - FFP and platelets
    - No benefit of rfVII
  - Post-operative
    - Same
OPTIMIZATION BY SYSTEMS

- **Nutrition**
  - Pre-operative, Post-operative
    - Maximize nutrition, no good evidence for hepatic formulas (including low-nitrogen)

- **Infectious Disease**
  - SBP
  - Sepsis
    - No difference in GDT in cirrhotic - harder
      - Inotropes less effective
      - Lactate metabolism
OPTIMIZATION

- Cardiac – Avoidance of inotropes
- Neuro – Encephalopathy - lactulose
- Renal –
  - Hyponatremia – fluid restriction
  - HRS – albumin, terlipressin, octreotide+midodrine
- Ascites
  - Diuretics, LVP w/ albumin
- Coagulopathy
  - Vitamin K, platelets and FFP
- Awareness of the precariousness of cirrhotic physiology, readiness to act
PATHWAY

Pt in need of non-hepatic surgery

H&P

Suspicuous for liver disease

Characterize
• LFTs
• Serology
• Imaging

Risk Stratification
• Other Patient Factors
• Risk Score
• Surgery Type

Unacceptable Risk
Pursue alternative therapy

Acceptable Risk
Optimize

Surgery

Manage post-operative care

GET SURGERY

No evidence of liver disease or cirrhosis
Continue pre-operative assessment
WHY RISK STRATIFY?

- Patients with cirrhosis need surgery
  - Umbilical hernia
  - Gallbladder
  - Colon
  - Cardiac
  - Emergency surgical conditions
  - Liver surgery and transplantation
- Patients with cirrhosis do worse
- The effects of surgery (and other stressors) are complicated and unpredictable
OTHER PATIENT FACTORS

### TABLE 1. Contraindications to Elective Surgery in Patients With Liver Disease

<table>
<thead>
<tr>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute viral hepatitis</td>
</tr>
<tr>
<td>Acute alcoholic hepatitis</td>
</tr>
<tr>
<td>Fulminant hepatic failure</td>
</tr>
<tr>
<td>Severe chronic hepatitis</td>
</tr>
<tr>
<td>Child’s class C cirrhosis</td>
</tr>
<tr>
<td>Severe coagulopathy (prolongation of the prothrombin time of &gt;3 seconds despite vitamin K administration; platelet count &lt;50,000/mm³)</td>
</tr>
<tr>
<td>Severe extrahepatic complications</td>
</tr>
<tr>
<td>Hypoxemia</td>
</tr>
<tr>
<td>Cardiomyopathy, heart failure</td>
</tr>
<tr>
<td>Acute renal failure</td>
</tr>
</tbody>
</table>

The Risk of Surgery in Patients With Liver Disease

**Lawrence S. Friedman**

**HEPATOLOGY Vol. 29, No. 6, 1999**
OTHER PATIENT FACTORS

- Hepatopulmonary Syndrome
  - Up to 50% of cirrhotic patients
  - Significant increase in mortality
    - Median survival 11 months
  - No studies on effect on post-op mortality
  - Irreversible cause of hypoxia
OTHER PATIENT FACTORS

- Hepatopulmonary Syndrome Algorithm

[Diagram of the Hepatopulmonary Syndrome Algorithm]

- Screening of LT candidates: patients with hepatic disease and dyspnoea
- Pulse oximetry
- Abnormal $\text{SaO}_2 < 96%$
  - ABG
    - $P(A-a)O_2$ gradient $< 15$ mmHg and $\text{PaO}_2 > 80$ mmHg: no HPS
    - $P(A-a)O_2$ gradient $> 15$ mmHg and $\text{PaO}_2 < 80$ mmHg: MTTE
      - no intrapulmonary shunting
        - Exclude other causes of pulmonary disease
      - Intrapulmonary shunting
        - Pulmonary function test
          - HPS alone
            - $\text{PaO}_2 < 60$ mmHg: SE MELD LT
            - $\text{PaO}_2 > 60$ mmHg: follow-up ABG
              - SE MELD LT
              - No SE MELD LT
          - Intrinsic lung disease
            - Treatment
- Normal $\text{SaO}_2 \geq 96%$
  - Stop
RISK SCORES: CHILD-TURCOTTE-PUGH

- 1964 - Child & Turcotte
- Mortality after shunting surgery for portal htn
- Variables, original:
  - Albumin
  - Bilirubin
  - Encephalopathy
  - Ascites
  - Nutritional status
RISK SCORES: CHILD-TURCOTTE-PUGH

- 1973 - Pugh et al “Transection of the oesophagus for bleeding oesophageal varices” (BJS)
- Mortality after surgery for bleeding varices
- Variables, updated:
  - Albumin
  - Bilirubin
  - Encephalopathy
  - Ascites
  - Nutritional status → Prothrombin time
RISK SCORES: CHILD-TURCOTTE-PUGH

- Ease of use, simplicity
- 40 years and 100s of papers
  - Ruptured esophageal varices
  - Subclinical encephalopathy
  - Hepatocellular carcinoma
  - Alcoholic cirrhosis
  - Decompensated HCV-related cirrhosis
  - Primary sclerosing cholangitis
  - Primary biliary cirrhosis
  - Budd–Chiari syndrome
  - Liver surgery and transplant
  - Mortality after non-hepatic surgery
1997

92 patients with cirrhosis undergoing emergent or elective surgery

54 variables evaluated retrospectively

CTP score most predictive of mortality

The study thought of as the “validation” study as the mortality figures mirror those from original paper.
Risk Scores: Child-Turcotte-Pugh

- MDCalc

**REFERENCES**

**Original/Primary Reference**


**Validation**

RISK SCORES: CHILD-TURCOTTE-PUGH

Disadvantages:
- Ascites and encephalopathy are SUBJECTIVE
- Validation has been mainly in RETROSPECTIVE studies with SMALL study populations
- Variables NOT WEIGHTED
- CAUSE of cirrhosis not included
- SURGERY type not included
Risk Scores: MELD

- MELD: Model for End-stage Liver Disease

A Model to Predict Poor Survival in Patients Undergoing Transjugular Intrahepatic Portosystemic Shunts

Michael Malinchoc, Patrick S. Kamath, Fredric D. Gordon, Craig J. Peine, Jeffrey Rank, and Pieter C. J. ter Borg

- 2000 – retrospective
- 231 patients who underwent TIPS
- Cox-proportio...(statistics) →
- 3 weighted variables: bilirubin, INR, creatinine
Risk Scores: MELD

A Model to Predict Survival in Patients With End-Stage Liver Disease

Patrick S. Kamath,1 Russell H. Wiesner,1 Michael Malinchoc,2 Walter Kremers,2 Terry M. Therneau,2 Catherine L. Kosberg,1 Gennaro D’Amico,3 E. Rolland Dickson,1 and W. Ray Kim1,2

Hepatology Vol. 33, No. 2, 2001

- Validation with 4 larger data sets (n=282 to n=1179)
- Mortality overall, unrelated to undergoing a procedure
- Allogenic transplant allocation
**Risk Scores: MELD**

- MDCalc

**References**

**Original/Primary Reference**


**Validation**


**Other References**

Risk Scores: MELD

Child-Turcotte-Pugh versus MELD score as a predictor of outcome after elective and emergent surgery in cirrhotic patients

Neil Farnsworth, B.A., Shawn P. Fagan, M.D., David H. Berger, M.D., Samir S. Awad, M.D.*
Risk Scores: MELD

- 2004 - prospective
- 40 patients undergoing elective (n=24) or emergent (n=16) surgical procedures
- CTP and MELD

<table>
<thead>
<tr>
<th>Score</th>
<th>% patients</th>
<th>1-month mortality %</th>
<th>3-month mortality %</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTP (A)</td>
<td>32 (n = 13)</td>
<td>15 (n = 2)</td>
<td>15 (n = 2)</td>
</tr>
<tr>
<td>CTP (B)</td>
<td>55 (n = 22)</td>
<td>9 (n = 2)</td>
<td>32 (n = 7)</td>
</tr>
<tr>
<td>CTP (C)</td>
<td>13 (n = 5)</td>
<td>60 (n = 3)</td>
<td>60 (n = 3)</td>
</tr>
<tr>
<td>MELD ≤8</td>
<td>30 (n = 12)</td>
<td>8 (n = 1)</td>
<td>8 (n = 1)</td>
</tr>
<tr>
<td>MELD 9–16</td>
<td>52 (n = 21)</td>
<td>10 (n = 2)</td>
<td>33 (n = 7)</td>
</tr>
<tr>
<td>MELD ≥17</td>
<td>18 (n = 7)</td>
<td>57 (n = 4)</td>
<td>57 (n = 4)</td>
</tr>
</tbody>
</table>
Risk Scores: MELD

Advantages:
- All variables are OBJECTIVE
- Validation for overall mortality risk has utilized LARGE study populations
- Variables WEIGHTED
  - MELD = 3.78×ln[serum bilirubin (mg/dL)] + 11.2×ln[INR] + 9.57×ln[serum creatinine (mg/dL)] + 6.43

Disadvantages
- Assessment of mortality in cirrhotic patients after surgery continued to rely on SMALL data sets
- CAUSE of cirrhosis not included
- SURGERY type not included
RISK SCORES - WHAT TO USE?

CLINICAL-LIVER, PANCREAS, AND BILIARY TRACT

Risk Factors for Mortality After Surgery in Patients With Cirrhosis

SWEE H. TEH,* DAVID M. NAGORNEY,* SUSANNA R. STEVENS,* KENNETH P. OFFORD,† TERRY M. THERNEAU,* DAVID J. PLEVAK,* JAYANT A. TALWALKAR,* W. RAY KIM,* and PATRICK S. KAMATH†

*Division of Gastroenterologic and General Surgery, †Division of Biostatistics, ‡Department of Anesthesiology, and §Division of Gastroenterology and Hepatology, Mayo Clinic, Rochester, Minnesota
Risk Scores - What to use?

- 2007 - retrospective
- 772 cirrhotic patients undergoing digestive (n=586), orthopedic (n=107) or cardiac surgery (n=79)
- Multivariable analysis (w/ statistics)
<table>
<thead>
<tr>
<th>Factor</th>
<th>30 days HR (95% CI)</th>
<th>P value</th>
<th>90 days HR (95% CI)</th>
<th>P value</th>
<th>1 year HR (95% CI)</th>
<th>P value</th>
<th>After 1 year HR (95% CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>MELD score &gt;8</td>
<td>1.12 (1.07-1.17)</td>
<td>&lt;.001</td>
<td>1.11 (1.06-1.16)</td>
<td>&lt;.001</td>
<td>1.12 (1.09-1.16)</td>
<td>&lt;.001</td>
<td>1.05 (1.00-1.10)</td>
<td>.04</td>
</tr>
<tr>
<td>CTP score &gt;7</td>
<td>1.14 (0.62-2.10)</td>
<td>.67</td>
<td>1.31 (0.79-2.18)</td>
<td>.30</td>
<td>1.21 (0.81-1.79)</td>
<td>.35</td>
<td>1.08 (0.74-1.57)</td>
<td>.68</td>
</tr>
<tr>
<td>Age*</td>
<td>1.26 (1.01-1.56)</td>
<td>.04</td>
<td>1.27 (1.05-1.54)</td>
<td>.01</td>
<td>1.22 (1.08-1.37)</td>
<td>&lt;.001</td>
<td>1.52 (1.39-1.67)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>ASA class IV</td>
<td>2.21 (1.26-3.86)</td>
<td>.005</td>
<td>2.70 (1.68-4.34)</td>
<td>&lt;.001</td>
<td>2.26 (1.64-3.11)</td>
<td>&lt;.001</td>
<td>1.47 (1.06-2.04)</td>
<td>.02</td>
</tr>
<tr>
<td>Surgery type*</td>
<td>.60</td>
<td>.79</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>2.33 (0.61-8.96)</td>
<td>.22</td>
<td>1.63 (0.55-4.86)</td>
<td>.38</td>
<td>1.20 (0.61-2.36)</td>
<td>.59</td>
<td>1.03 (0.66-1.60)</td>
<td>.90</td>
</tr>
<tr>
<td>Digestive A</td>
<td>1.90 (0.58-6.27)</td>
<td>.29</td>
<td>1.56 (0.61-3.97)</td>
<td>.35</td>
<td>1.95 (1.15-3.31)</td>
<td>.01</td>
<td>0.92 (0.67-1.26)</td>
<td>.60</td>
</tr>
<tr>
<td>Digestive B</td>
<td>1.57 (0.44-5.61)</td>
<td>.48</td>
<td>1.39 (0.51-3.76)</td>
<td>.52</td>
<td>1.64 (0.95-2.86)</td>
<td>.08</td>
<td>0.93 (0.66-1.31)</td>
<td>.68</td>
</tr>
<tr>
<td>Orthopedic</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency surgery</td>
<td>1.72 (0.87-3.38)</td>
<td>.12</td>
<td>1.54 (0.87-2.72)</td>
<td>.14</td>
<td>1.55 (1.08-2.22)</td>
<td>.02</td>
<td>0.71 (0.46-1.09)</td>
<td>.12</td>
</tr>
<tr>
<td>Year of surgery</td>
<td>0.96 (0.88-1.05)</td>
<td>.39</td>
<td>0.99 (0.92-1.07)</td>
<td>.77</td>
<td>0.94 (0.89-0.98)</td>
<td>.009</td>
<td>1.02 (0.98-1.06)</td>
<td>.34</td>
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<tr>
<td>Etiology of disease*</td>
<td>.27</td>
<td>.16</td>
<td></td>
<td>.005</td>
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<tr>
<td>Alcoholic</td>
<td>1.19 (0.61-2.32)</td>
<td>.62</td>
<td>1.23 (0.70-2.15)</td>
<td>.48</td>
<td>1.49 (1.09-2.04)</td>
<td>.01</td>
<td>1.12 (0.86-1.45)</td>
<td>.40</td>
</tr>
<tr>
<td>Cholestatic</td>
<td>0.48 (0.16-1.40)</td>
<td>.18</td>
<td>0.50 (0.21-1.22)</td>
<td>.13</td>
<td>0.71 (0.45-1.13)</td>
<td>.15</td>
<td>1.23 (0.94-1.63)</td>
<td>.14</td>
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<tr>
<td>Viral/other</td>
<td>1.00</td>
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<tr>
<td>Male sex</td>
<td>1.79 (1.03-3.11)</td>
<td>.04</td>
<td>1.74 (1.09-2.77)</td>
<td>.02</td>
<td>1.45 (1.09-1.93)</td>
<td>.01</td>
<td>1.05 (0.84-1.30)</td>
<td>.67</td>
</tr>
</tbody>
</table>
This calculator is intended for use by health care providers. The results of this tool should never be used alone to determine a patient's medical treatment. This tool is a statistical model and is not a substitute for an individual treatment plan developed by a doctor with personal knowledge of a specific patient. Other important factors that must be considered include the patient's own medical history and the experience, knowledge and training of the doctor. Doctors should personally discuss these results with patients when presenting prognoses or treatment recommendations.

To determine the risk of post-operative mortality for all types of major surgery, especially gastro-intestinal, orthopedic and cardiac surgery (includes open-heart procedures), please enter the following variables:

- What is the age? 73
- What is the ASA score? Enter 3 for compensated cirrhosis, Enter 4 for decompensated cirrhosis
- What is the bilirubin? 2.7 (mg/dl)
- What is the creatinine? 1.3 (mg/dl)
- What is the INR? 1.8
- What is the etiology of cirrhosis? Alcoholic or Cholestatic, Viral/Other

Compute
Reset
This calculator is intended for use by health care providers. The results of this tool should never be used alone to determine a patient’s medical treatment. This tool is a statistical model and is not a substitute for an individual treatment plan developed by a doctor with personal knowledge of a specific patient. Other important factors that must be considered include the patient’s own medical history and the experience, knowledge and training of the doctor. Doctors should personally discuss these results with patients when presenting prognoses or treatment recommendations.

To determine the risk of post-operative mortality for all types of major surgery, especially gastrointestinal, orthopedic and cardiac surgery (includes open-heart procedures), please enter the following variables:

<table>
<thead>
<tr>
<th>What is the age?</th>
<th>73</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the ASA score?</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>What is the bilirubin?</td>
<td>2.7 (mg/dl)</td>
</tr>
<tr>
<td>What is the creatinine?</td>
<td>1.3 (mg/dl)</td>
</tr>
<tr>
<td>What is the INR?</td>
<td>1.8</td>
</tr>
</tbody>
</table>

What is the etiology of cirrhosis?  
- Alcohol or Cholestatic  
- Viral/Other

**Compute**

**Reset**

### Probability of Mortality

<table>
<thead>
<tr>
<th></th>
<th>7 days</th>
<th>30 days</th>
<th>90 days</th>
<th>1 year</th>
<th>5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability of Mortality</td>
<td>18.083%</td>
<td>55.889%</td>
<td>73.337%</td>
<td>79.196%</td>
<td>98.706%</td>
</tr>
</tbody>
</table>
IS THAT IT?

Pt in need of non-hepatic surgery

H&P

No evidence of liver disease or cirrhosis
Continue pre-operative assessment

GET SURGERY

Suspicious for liver disease

Characterize
• LFTs
• Serology
• Imaging

Risk Stratification
• Risk Score
• Other Patient Factors
• Surgery Type

Unacceptable Risk

Pursue alternative therapy

Acceptable Risk

Optimize

SURGERY

Manage post-operative care
Surgery Specific Factors

- Type of surgery has significant impact
Table 2. Univariate and Multivariable Determinants of Postoperative Mortality

<table>
<thead>
<tr>
<th>Factor</th>
<th>30 days HR (95% CI)</th>
<th>30 days P value</th>
<th>90 days HR (95% CI)</th>
<th>90 days P value</th>
<th>1 year HR (95% CI)</th>
<th>1 year P value</th>
<th>After 1 year HR (95% CI)</th>
<th>After 1 year P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>MELD score &gt;8</td>
<td>1.12 (1.07–1.17)</td>
<td>&lt;.001</td>
<td>1.11 (1.06–1.16)</td>
<td>&lt;.001</td>
<td>1.12 (1.09–1.16)</td>
<td>&lt;.001</td>
<td>1.05 (1.00–1.10)</td>
<td>.04</td>
</tr>
<tr>
<td>CTP score &gt;7</td>
<td>1.14 (0.62–2.10)</td>
<td>.67</td>
<td>1.31 (0.79–2.18)</td>
<td>.30</td>
<td>1.21 (0.81–1.79)</td>
<td>.35</td>
<td>1.08 (0.74–1.57)</td>
<td>.68</td>
</tr>
<tr>
<td>Agea</td>
<td>1.26 (1.01–1.56)</td>
<td>.04</td>
<td>1.27 (1.05–1.54)</td>
<td>.01</td>
<td>1.22 (1.08–1.37)</td>
<td>&lt;.001</td>
<td>1.52 (1.39–1.67)</td>
<td>&lt;.001</td>
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<tr>
<td>Hypertension</td>
<td>2.01 (1.00–3.28)</td>
<td>.045</td>
<td>2.70 (1.46–4.96)</td>
<td>.001</td>
<td>2.96 (1.51–5.84)</td>
<td>.001</td>
<td>1.43 (1.28–1.61)</td>
<td>.26</td>
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<tr>
<td>Multivariable analysis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgery typeb</td>
<td>2.33 (0.61–8.96)</td>
<td>.22</td>
<td>1.63 (0.55–4.86)</td>
<td>.38</td>
<td>1.20 (0.61–2.36)</td>
<td>.59</td>
<td>1.03 (0.66–1.60)</td>
<td>.90</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>1.90 (0.58–6.27)</td>
<td>.29</td>
<td>1.56 (0.61–3.97)</td>
<td>.35</td>
<td>1.95 (1.15–3.31)</td>
<td>.01</td>
<td>0.92 (0.67–1.26)</td>
<td>.60</td>
</tr>
<tr>
<td>Digestive A</td>
<td>1.57 (0.44–5.61)</td>
<td>.48</td>
<td>1.39 (0.51–3.76)</td>
<td>.52</td>
<td>1.64 (0.95–2.86)</td>
<td>.08</td>
<td>0.93 (0.66–1.31)</td>
<td>.68</td>
</tr>
<tr>
<td>Orthopedic</td>
<td>1.00</td>
<td>—</td>
<td>1.00</td>
<td>—</td>
<td>1.00</td>
<td>—</td>
<td>1.00</td>
<td>—</td>
</tr>
<tr>
<td>Emergent surgery</td>
<td>2.72 (0.97–7.32)</td>
<td>.12</td>
<td>1.54 (0.87–2.72)</td>
<td>.11</td>
<td>1.55 (1.02–2.32)</td>
<td>.02</td>
<td>0.71 (0.46–1.09)</td>
<td>.12</td>
</tr>
<tr>
<td>Year of surgery</td>
<td>0.96 (0.88–1.05)</td>
<td>.39</td>
<td>0.99 (0.92–1.07)</td>
<td>.77</td>
<td>0.94 (0.89–0.98)</td>
<td>.009</td>
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<td>.34</td>
</tr>
<tr>
<td>Etiology of diseasec</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
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<td>Alcoholic</td>
<td>1.19 (0.61–2.32)</td>
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<td>.12</td>
<td>1.23 (0.94–1.63)</td>
<td>.14</td>
</tr>
<tr>
<td>Viral/other</td>
<td>1.00</td>
<td>—</td>
<td>1.00</td>
<td>—</td>
<td>1.00</td>
<td>—</td>
<td>1.00</td>
<td>—</td>
</tr>
<tr>
<td>Male sex</td>
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<td>.02</td>
<td>1.45 (1.09–1.93)</td>
<td>.01</td>
<td>1.05 (0.84–1.30)</td>
<td>.67</td>
</tr>
</tbody>
</table>
UMBILICAL HERNIA

- Significant problem in cirrhotics
  - 20% prevalence, 40-50% in setting of ascites
  - Enlarge over time
  - Skin breakdown and necrosis
  - SBP

- What role do risk scores play?
- Surgery for UH an exception to these scores?
UMBILICAL HERNIA

Umbilical Herniorrhaphy in Cirrhotic Patients

John P. Leonetti, MD; Gerard V. Aranha, MD; William A. Wilkinson, MD; Malcolm Stanley, MD; Herbert B. Greenlee, MD

Arch Surg—Vol 119, April 1984

<table>
<thead>
<tr>
<th>Group</th>
<th>Characteristic</th>
<th>n</th>
<th>Mortality</th>
<th>Peritonitis/ GI Hemorrhage</th>
<th>Wound Infection</th>
<th>Recurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cirrhotic, functioning shunt</td>
<td>15</td>
<td>0 (0)</td>
<td>1 (6.6)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>2</td>
<td>Cirrhotic, nonfunctioning and no shunts</td>
<td>24</td>
<td>2 (8.3)</td>
<td>1 (4)</td>
<td>3 (12.5)</td>
<td>4 (16.6)</td>
</tr>
<tr>
<td>3</td>
<td>Noncirrhotic</td>
<td>53</td>
<td>1 (1.8)</td>
<td>0 (0)</td>
<td>1 (7.8)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

*GI indicates gastrointestinal. Significant findings were as follows: mortality, group 1 v 2 (P<.05); peritonitis/GI hemorrhage, group 2 v 3 (P<.05); wound infection, group 2 v 3 (P<.05); and recurrence, group 1 v 2 (P<.01) and group 2 v 3 (P<.01).
Umbilical hernia repair in the presence of cirrhosis and ascites: results of a survey and review of the literature

A. McKay · E. Dixon · O. Bathe · F. Sutherland

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Total Patients</th>
<th>Total Mortality</th>
<th>Total Morbidity</th>
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<tbody>
<tr>
<td>Lemmer et al. [3]</td>
<td>1983</td>
<td>9</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Pescovitz [18]</td>
<td>1984</td>
<td>22</td>
<td>1</td>
<td>18</td>
</tr>
<tr>
<td>Bunt and Mohr [19]</td>
<td>1985</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>O’Connor et al. [9]</td>
<td>1984</td>
<td>9</td>
<td>0</td>
<td>2</td>
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<tr>
<td>Runyon and Juler [14]</td>
<td>1985</td>
<td>22</td>
<td>0</td>
<td>4</td>
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<tr>
<td>Belghiti et al. [8]</td>
<td>1990</td>
<td>40</td>
<td>0</td>
<td>5</td>
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<tr>
<td>MacLellan et al. [20]</td>
<td>1990</td>
<td>1</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Maniatis and Hunt [6]</td>
<td>1995</td>
<td>1</td>
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<td>Ozden et al. [21]</td>
<td>1998</td>
<td>9</td>
<td>0</td>
<td>3</td>
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<tr>
<td>de la Peña et al. [16]</td>
<td>2000</td>
<td>15</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Granese et al. [22]</td>
<td>2002</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sarit et al. [23]</td>
<td>2003</td>
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</tr>
<tr>
<td>Fagan et al. [24]</td>
<td>2004</td>
<td>3</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Sherman and Lee [25]</td>
<td>2004</td>
<td>1</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Slakey et al. [10]</td>
<td>2005</td>
<td>8</td>
<td>0</td>
<td>0</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td>135</td>
<td>4 (2.7%)</td>
<td>39 (21%)</td>
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</tbody>
</table>
UMBILICAL HERNIA

32,033 patients who underwent abdominal wall hernias between 1999 and 2004 (excluding inguinal)

1197 cirrhotic patients

Emergency surgery performed in 60% of cirrhotics (vs 30% non-cirrhotics)

Does not include table comparison between study groups
UMBILICAL HERNIA

Alfredo M. Carbonell · Luke G. Wolfe · Eric J. DeMarla

Poor outcomes in cirrhosis-associated hernia repair: a nationwide cohort study of 32,033 patients

<table>
<thead>
<tr>
<th></th>
<th>Cirrhotic</th>
<th>Non-cirrhotic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of Stay (Days)</td>
<td>5.4</td>
<td>3.7</td>
<td>-</td>
</tr>
<tr>
<td>% ICU Cases</td>
<td>15.9</td>
<td>6.0</td>
<td>0.0001</td>
</tr>
<tr>
<td>Morbidity Rate (%)</td>
<td>16.5</td>
<td>13.8</td>
<td>0.008</td>
</tr>
<tr>
<td>Mortality Rate (%)</td>
<td>2.5</td>
<td>0.2</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

Fig. 3 Overall outcomes of cirrhotic vs non-cirrhotic patients
UMBILICAL HERNIA

Alfredo M. Carbonell · Luke G. Wolfe · Eric J. DeMaria

Poor outcomes in cirrhosis-associated hernia repair: a nationwide cohort study of 32,033 patients

<table>
<thead>
<tr>
<th></th>
<th>Non-emergent</th>
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<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Cirrhotic</td>
<td>Non-cirrhotic</td>
<td>p-value</td>
</tr>
<tr>
<td>Length of Stay (Days)</td>
<td>4.1</td>
<td>3.4</td>
<td>-</td>
</tr>
<tr>
<td>% ICU Cases</td>
<td>7.1</td>
<td>5.1</td>
<td>0.11</td>
</tr>
<tr>
<td>Morbidity Rate (%)</td>
<td>15.6</td>
<td>13.5</td>
<td>0.18</td>
</tr>
<tr>
<td>Mortality Rate (%)</td>
<td>0.6</td>
<td>0.1</td>
<td>0.06</td>
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</table>

Fig. 5 Outcomes of cirrhotic and non-cirrhotic patients in non-emergent surgery

<table>
<thead>
<tr>
<th></th>
<th>Emergent</th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cirrhotic</td>
<td>Non-cirrhotic</td>
<td>p-value</td>
</tr>
<tr>
<td>Length of Stay (Days)</td>
<td>6.4</td>
<td>4.3</td>
<td>-</td>
</tr>
<tr>
<td>% ICU Cases</td>
<td>22.1</td>
<td>7.9</td>
<td>0.0001</td>
</tr>
<tr>
<td>Morbidity Rate (%)</td>
<td>17.2</td>
<td>14.5</td>
<td>0.04</td>
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<tr>
<td>Mortality Rate (%)</td>
<td>3.8</td>
<td>0.5</td>
<td>0.0001</td>
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</tbody>
</table>

Fig. 6 Outcomes of cirrhotic and non-cirrhotic patients in emergent surgery
UMBILICAL HERNIA

Management of complicated umbilical hernias in cirrhotic patients using permanent mesh: randomized clinical trial

S. A. Ammar

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Comparison between the two groups</th>
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<tr>
<td></td>
<td>Group I</td>
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<tr>
<td>Number</td>
<td>35</td>
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<tr>
<td>Male/female</td>
<td>29:6</td>
</tr>
<tr>
<td>Mean age (in years) ± SD</td>
<td>50.6 ± 8.29</td>
</tr>
<tr>
<td>Child-Pugh class</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>5</td>
</tr>
<tr>
<td>B</td>
<td>30</td>
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<tr>
<td>Hernia complication</td>
<td></td>
</tr>
<tr>
<td>Incarceration</td>
<td>30</td>
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<tr>
<td>Inflammation</td>
<td>3</td>
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<td>Rupture/leakage</td>
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<tr>
<td>Anesthesia</td>
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<td>Local</td>
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<td>Spinal</td>
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<td>General</td>
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<tr>
<td>Mean hernia size (cm) ± SD</td>
<td>5.4 ± 3.03</td>
</tr>
<tr>
<td>Mean duration of hospital stay (days) ± SD</td>
<td>4.4 ± 1.63</td>
</tr>
</tbody>
</table>

NS not significant (P-value > 0.05)
UMBILICAL HERNIA

Management of complicated umbilical hernias in cirrhotic patients using permanent mesh: randomized clinical trial

S. A. Ammar

Table 2 Postoperative complications

<table>
<thead>
<tr>
<th>Complication</th>
<th>Group I</th>
<th>Group II</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Hematoma/seroma</td>
<td>3</td>
<td>8.5</td>
<td>4</td>
</tr>
<tr>
<td>Transient ascitic fluid leakage</td>
<td>5</td>
<td>14.2</td>
<td>4</td>
</tr>
<tr>
<td>Surgical site infection (SSI)</td>
<td>3</td>
<td>8.5</td>
<td>6</td>
</tr>
<tr>
<td>Hernia recurrence</td>
<td>5</td>
<td>14.2</td>
<td>1</td>
</tr>
</tbody>
</table>

NS not significant (P-value > 0.05)
SUMMARY 1

- Pre- and Post-operative issues in cirrhotics
  1. There are dysfunctions related to cirrhosis that deserve special attention
  2. Awareness of the precariousness of cirrhotic physiology, readiness to act
SUMMARY 2

- Risk stratification for cirrhotic patients undergoing non-hepatic surgery includes:
  1. Review and consider contraindications to elective surgery, including HPS
  2. Calculation of a risk score, of which the Mayo Clinic augmented MELD appears the most robust
  3. Consideration of surgery specific data on morbidity and mortality
SUMMARY 3

- Umbilical hernia repair in cirrhotic patients
  - Is safe, with acceptable morbidity and mortality
  - When performed under elective conditions, has comparable morbidity and mortality to non-cirrhotics
  - Should be performed when found to avoid the increase in mortality under emergent conditions
  - Can probably be performed using synthetic mesh
www.downstatesurgery.org
### APACHE II Score

**AGE Points**
- ≤ 44y: 0
- 45-54y: 2
- 55-64y: 3
- 65-74y: 5
- ≥ 75y: 6

**CHRONIC HEALTH Points**
- Non-operative, or emergency post-op & any conditions below: 5
- Elective operation & any conditions below: 2

**TOTAL APACHE SCORE = AP + CHP + APS**

Sum Age Points (AP) + Chronic Health Points (CHP) + Acute Physiologic Score (APS) points.

1. Sum all variables 1-12 for Acute Physiologic Score (APS) (use one variable each for 5 and 9).
2. Use the worst value from the preceding 24h.

### ACUTE PHYSIOLOGIC SCORE*1 (APS)

<table>
<thead>
<tr>
<th>Physiologic Variable</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Temp °F</td>
<td>&lt;95.9</td>
</tr>
<tr>
<td></td>
<td>≤29.9</td>
</tr>
<tr>
<td>HR, bpm</td>
<td>≤39</td>
</tr>
<tr>
<td>MAP, mmHg</td>
<td>≤48</td>
</tr>
<tr>
<td>RR, bpm</td>
<td>≤5</td>
</tr>
</tbody>
</table>

5. Oxygenation: Use A-a Gradient (5a) if FIO2 ≥0.5 or use PaO2 (5b) if FIO2 <0.5 (see page 17)

5a A-a Gradient
- ≤64
- 55-60
- 61-70
- >70

5b PaO2
- ≤110
- 111-119
- 120-129
- 130-139
- 150-154
- 155-169
- 160-179
- ≥180

6. Na⁺ (S, mmo/L)
- ≤140
- 141-149
- 150-154
- 155-159
- 160-179
- ≥180

7. K⁺ (S, mmo/L)
- ≤2.4
- 2.5-2.9
- 3.0-3.4
- 3.5-5.4
- 5.5-5.9
- ≥6.0

8. Cr (S, mg/dL)
- ≤0.6
- 0.7-1.4
- 1.5-1.9
- ≥2.0

9. Arterial pH is preferred. Use venous HCO3 if no ABGs.

9a pH (arterial)
- ≤7.14
- 7.15-7.24
- 7.25-7.32
- 7.33-7.49
- 7.5-7.59
- 7.6-7.69
- ≥7.7

9b HCO₃⁻ (venous)
- ≤14
- 15-17.9
- 18-21.9
- 22-31.9
- 32-40.9
- 41-51.9
- ≥52

10. WBC, cells/μL
- ≤3.0
- 3.1-6.0
- 6.1-10.9
- 11-15.9
- 16-20.9
- ≥21

11. Hct, %
- ≤20
- 20-29.9
- 30-45.9
- 46-49.9
- 50-59.9
- ≥60

12. GCS coma
- Score = 15 – GCS Score (see below, Record e.g. "GCS 9 = E2 V4 M3 at 17:35h")

### GCS Scale

<table>
<thead>
<tr>
<th>Score</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>4%</td>
</tr>
<tr>
<td>5-9</td>
<td>4%</td>
</tr>
<tr>
<td>10-14</td>
<td>15%</td>
</tr>
<tr>
<td>15-19</td>
<td>25%</td>
</tr>
<tr>
<td>20-24</td>
<td>40%</td>
</tr>
<tr>
<td>25-29</td>
<td>55%</td>
</tr>
<tr>
<td>30-34</td>
<td>75%</td>
</tr>
<tr>
<td>&gt;34</td>
<td>85%</td>
</tr>
</tbody>
</table>

### GLASGOW COMA SCALE (GCS)


<table>
<thead>
<tr>
<th>EYE Opening</th>
<th>Best VERBAL</th>
<th>Best MOTOR</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>follows commands</td>
<td>oriented</td>
<td>localizes pain</td>
<td>6</td>
</tr>
<tr>
<td>spontaneous</td>
<td>confused</td>
<td>withdraws to pain</td>
<td>4</td>
</tr>
<tr>
<td>to command</td>
<td>inappropriate words</td>
<td>flexor response</td>
<td>3</td>
</tr>
<tr>
<td>to painful stimuli</td>
<td>incomprehensible</td>
<td>extension (abnl)</td>
<td>2</td>
</tr>
<tr>
<td>no response</td>
<td>no response</td>
<td>no response</td>
<td>1</td>
</tr>
</tbody>
</table>

**SCORE:**

Sum Points (eye+verbal+motor categ).

Severe ≤ 8.
Mod = 9-12.
Minor ≥ 13.