U of L Acute Liver Failure Orders (revised 8/27/09)
ADMISSION ORDERS ONLY
(only orders circled will be initiated)

1. Admit to ICUS (Unit F or G) only under U of L GI/Hepatology
2. Diagnosis: Acute (Fulminant) Liver Failure
3. Condition and Prognosis: Grave
4. Allergies:_____
5. Obtain accurate: Height_____ Weight_____ Lb or Kg (circle)
6. Calculate/obtain (nursing to calculate): **Predicted Body Weight** (same as Ideal Body Weight) and chart: PBW _____ Kg
   http://www.ardsnet.org/node/77460
   Men= 50 + 2.3 x (height in inches – 60)
   Women= 45 + 2.3 x (height in inches – 60)
7. Hepatology to calculate, confirm, and chart **Lean Body Weight: LBW** _____Kg
   http://www.medcalc.com/body.html
   LBW men= (1.10 x Weight(kg))- 128($Weight^2$/(100 x Height(m))^2)
   LBW women = (1.07 x Weight(kg)) -148($Weight^2$/(100 x Height(m))^2)
8. Diet: 2 gm sodium, 1-1.5 gm protein/kg, 30 kcal/kg/d, in 3 meals plus 4 snacks, 1500ml/day total fluid restriction, while fully awake only.
9. For confused or lethargic patients, keep NPO and ask Hepatology to place endoscopic N-J tube.
10. Calorie Count: for patients eating less than 70% of needs, or has endotracheal – intubation; ask Hepatology to place endoscopic Naso-jejunal or Oro-jejunal feeding tube.
11. For patients with a feeding tube, start NutriHep-Beneprotein (1-1.5 g protein/kg, 30kcal/kg/d) at 30cc/h for 4 hours, then increase to 60 cc/hr for 4 hours, then increase to goal rate. For a feeding tube placed in the stomach, do not hold unless "residuals" are greater than 300 ml. For a feeding tube placed in the small bowel, do not check "residuals."
12. Consults:
    a. Psychiatry: "Patient with Fulminant Liver Failure; please evaluate psychological/psychiatric axis and risk."
    b. U of L Transplant Surgery: "Fulminant Liver Failure"; please evaluate for risk and assist with management."
    c. Pulmonary and Critical Care Intensivist: _____ "Patient with Acute Liver Failure; evaluate and assist with management"
    d. Transplant Social Worker: "Fulminant Liver Failure"; evaluate social risk of patient and family, and assist with urgent need for insurance coverage.
    e. Consult Dietitian: "Nutritional needs."
13. For patients who develop SIRS by having two or more of the following criteria or have an intracranial pressure monitor placed, call Hepatology for an infectious disease consult for broad spectrum antibiotics and antifungals:
    a. Temperature greater than 38 or less than 35 degrees C
    b. Heart rate greater than 90 beats/min

c. Respiratory rate greater than 20 breaths/min or $PaCO_2$ less than 32 mmHg
d. WBC greater than 12,000 cells/mm3, less than 4,000 cells/mm3, or greater than 10 percent immature (bands) forms.

14. Consult Infectious Disease, Dr. _____ for broad spectrum antibiotics and antifungals.
15. Continuous pulse oximetry; keep O_2 sat greater than or equal to 92% giving O_2 as needed. Call Hepatology for O_2 sat less than 92%.
16. Continuous CVP. Keep CVP between 10-15; If CVP less than 10, give boluses of 250 ml each, of 5% albumin up to 6 doses; then give boluses of 500 ml of 0.9% NaCl as needed until CVP is 10-15; call Hepatoloy for CVP greater than 15.
17. Place intermittent pneumatic leg compression device.
18. IV Fluids: 1000 ml D10NS at 85 ml/h; 1 vial MVI + 1 amp trace elements + 100 mg Thiamine + 500 mg Vitamin C in 1000 ml D10NS once a day. Once tolerating diet/tube-feeds, change to saline lock.
19. All IV catheters should be locked with normal saline only; do not give heparin.
20. Cleanse skin before placement of any IV catheters and for all subsequent care with chlorhexidine gluconate (HIBICLENS).
21. Remove all body piercing decorations.
22. Give Artificial Saliva, as needed for dry mouth while awake, while patient is on "fluid restricted diet."
23. Call Hepatology for any of the following (anticipate initiation of APPENDIX A: ALF COAGULOPATHY AND INVASIVE PROCEDURE PROTOCOL):
    a. Invasive procedure needed and INR >1.9 or platelets < 50,000
    b. Intracranial pressure monitor needed and INR >1.7 or platelets < 50,000
    c. Patient has petechiae or mucosal bleeding with platelets =/< 20,000
    d. Platelets less than or equal to 10,000
    e. Active bleeding and platelets less than 50,000
    f. Fibrinogen less than 150 mg/dL in patient bleeding, or in need of invasive procedure.
24. MD to initiate APPENDIX A: ALF COAGULOPATHY AND INVASIVE PROCEDURE PROTCOL
25. IV access: Transplant surgery or Intensivist to place an INTERNAL JUGULAR ScvO2 capable triple lumen catheter. Ask them if they want "SiteRight" or ultrasound guidance, and if needed, order equipment. Before placement of central line, correct coagulopathy (if applicable).
26. Place Foley catheter to monitor urine output ONLY in the following:
    a) Urine output for previous 6 hours is less than 300ml or
    b) Previously normal creatinine raises to =/greater than 1.5 mg/dl or
    c) Patient is intubated or
    d) Patient is confused
27. When F/C placed, monitor intra-abdominal pressure using the AbVisor device. Call Hepatology for IAP greater then 15 or if Abdominal Perfusion Pressure (APP) = MAP-IAP < 60 mmHg (anticipate initiation of Appendix H: ALF Abdominal Hypertension Protocol).

28. Strict I/O: call for urine output less than or equivalent to 50 cc/hr for 6 hours or a previously normal creatinine rises to or > than 1.5 mg/dL. For urine output less than 50 cc/hr obtain BMP every 4 hours. Call results to Hepatology (anticipate initiation of APPENDIX C (either C1 or C2): ALF HEMODYNAMIC MANAGEMENT PROTOCOL).
29. Free-water restriction:
    a) Give all IV medications in normal saline: For medications not compatible with normal saline, give medication maximally concentrated in 0.45% NaCL or D5W, in that order of choice.
    b) Minimize amount of water in all oral medications, and all medications given by tube.
30. Neuro checks every hour.
31. For temperature greater than 37 degrees C, control temperature with cooling blanket to keep temperature less than or equal to 36.5 degrees C.
32. Check blood glucose on arrival to ICU and every 2 hours:
    a) Keep blood glucose above 70 mg/dl. Follow hypoglycemic protocol for BG less than 70.
    b) Follow ICU standing insulin orders when appropriate (VF #7324545).
33. Use Electrolyte Replacement Protocol (VF #7325849) to correct potassium and magnesium. For phosphorus less than 2.7 mg/dL, call Hepatology for replacement orders.
34. DO NOT infuse NaCl until order received from MD. While NaCl infusing, obtain BMP every 6 hours and call results to Hepatology (serum Na goal 140-150 mEq/L).
    - Na less then 137 mEq/L, give 3% NaCl for a total volume of _____ mL over 24 hours, IV [3% NaCl volume in mL = **lean body weight** (in Kg) x 8 (mL/Kg)]; Hepatology to calculate volume; DO NOT infuse until order received from MD
    - Na 138-139, give 3% NaCl for a total volume of _____ mL over 24 hours, IV [3% NaCl volume in mL = **lean body weight** (in Kg) x 4 (mL/Kg)]; Hepatology to calculate volume; DO NOT infuse until order received from MD
35. Admission labs:
    a) Blood type, Rh and antibody screen in 2 different blood draws (for transplant)
    b) Serum HCG pregnancy test (females)
    c) CBC with diff
    d) PT, INR, PTT, Fibrinogen
    e) Factor-V quantitation
    f) CMP, Phosphorus, Mg, CK, Amylase, Lipase, TSH
    g) Cortisol on admission and in am
    h) Free Cortisol if albumin is less than or equal to 2.5g/dl
    i) Acetaminophen level
    j) ABG, arterial lactate, arterial phosphate, arterial ammonia
    k) RPR serology
    l) Rapid HIV serology

m) Anti-HSV I and II IgG and IgM
n) Anti-CMV IgG and IgM
o) Anti-EBV complete serology
p) HBsAg
q) anti-HBc total, anti-HBs titer, anti-HCV, anti-VZV
r) HCV-RNA quantitation with Reflex to high sensitivity-TMA (Dr. Marsano)
s) HBV DNA quantitation
t) Urine analysis with mircroscopic exam, urine eosinophiles
u) Spot urine Na, CL, K, and creatinine
v) Blood cultures (2 peripheral and all central or picc lines), urine and sputum cultures

36. AFP on day 1 (today) and day 3
37. Daily labs x 3 days:
    a) CBC with diff, PT/INR, PTT, Fibrinogen, CMP, arterial ammonia, Mg, Phosphorus
    b) Blood, sputum, urine and line cultures
    c) Fungal blood cultures
38. Unknown etiology special work up:
    a) **HAV:** anti-HAV IgM
    b) **HBV:** anti-HBc IgM (others in #19)
    c) **HCV:** HCV genotype (others in #19)
    d) **HDV:** anti-HDV IgG and IgM
    e) **HEV:** anti-HEV IgG and IgM
    f) **CMV:** CMV digene (others in #18)
    g) **HSV:** Buffy coat culture for HSV, serum Herpes Simplex PCR (others in #19)
    h) **EBV:** EBV-PCR in blood (others in #19)
    i) **VZV:** VZV-PCR in blood (others in #19)
    j) **Wilson's:** 24h urine Cu, serum ceruloplasmin, uric acid, total and free serum Cu, Consult U of L Opthamology for URGENT bed-side evaluation for Kayser-Fleischer rings: "Fulminant Hepatic Failure; evaluate for Wilson's disease"
    k) **Autoimmune:** ANA, anti-LKM, anti-SLA, ASMA, ANCA, AMA Rheumatoid factor, serum Quantitative IgG, IgA, and IgM
    l) **Alpha-1 antitrypsin:** phenotype and quantitation
    m) **Iron Overload:** Fe, TIBC, Transferrin saturation, Ferritin
    n) **Drug/Toxin:** urine and serum toxicology drug screen
    o) **Paramyxovirus and Adenovirus:** serum PCR for adenovirus, anti-paramyxovirus antibody
    p) **Budd-Chiari, Ischemia, liver neoplasia:** U/S and echo as in order #37.
39. MD to initiate APPENDIX B: POTENTIAL HIGHLY INFECTIOUS EXOTIC VIRUS PROTOCOL (Hepatology will order if patient has been on recent foreign travel)
40. Tests for all patients:

a) U/S of liver biliary tree, pancreas and both kidneys + Doppler of liver vessels (portal vein, hepatic veins, splenic vein, and hepatic artery): Fulminant liver failure: evaluate for liver tumor or liver ischemia": look for masses, steatosis, ascites, kidney/pancreas disease, and evaluate vascular flow."
b) Echocardiogram with delay /prolong "bubble study" to be read by: _____; "Fulminant hepatic failure and portal hypertension: evaluate cardiac function, for evidence of hepatopulmonary syndrome, and for portopulmonary hypertension."

41. EKG: "Fulminant liver failure- critically ill; assess for ischemia, arrhythmia and QTc interval."
42. Chest X-ray and Acute abdominal series X-ray: "fulminant hepatic failure; evaluate for pneumonia, ileus, or foreign body; in women evaluate if "intrauterine device" is present.
43. Inform Hepatology of reported presence of intrauterine devices or other foreign body from radiologist. For intrauterine device, consult U of L Gynecology to remove it: "Fulminant Liver Failure" with intrauterine device; please remove it due to infection risk."
44. Nexium 40 mg PO every day (IV for patients unable to take enterally)
45. Cytotec 200 mcg PO or by feeding tube every 8 hours (do not give to pregnant patients). Caution: pregnant NURSES must not handle tablets.
46. Vitamin K 10 mg PO or by FT every day, however limit to 3 doses a week in pregnancy. For patients not able to take orally, give 5 mg IV in 50 ml NS over 30 min daily.
47. Other vitamins (for patients not receiving vitamins in IVF's):
    Mutivitamin + Minerals, PO/FT daily
    Thiamine 100 mg PO/FT daily
    Vitamin C 500 mg PO/FT daily
48. Acetadote intravenously; <u>100mg per mL in 0.45% NS</u> for up to 7 days:
    a) Day 1: 150 mg/kg IV over 1 hour, then 50 mg/kg over 4h, then 100 mg/kg over 16h
    b) Day 2-7: 150 mg/kg/day continuous infusion until INR less than 2 or 7 days of therapy
49. Do NOT give:
    a. Sedatives/benzodiazepines or narcotics except for use in APPENDIX A
    b. NSAIDS except use in APPENDIX E
    c. Antiemetics other than Zofran or Kytril
    d. Aminoglycosides
    e. Heparin
50. Call Hepatology for (anticipate initiation of APPENDIX C (either C1 or C2): ALF HEMODYNAMIC MANAGEMENT PROTOCOL):
    a) Urine output less than 50 cc/hr for 6 hours with CVP 10-15 after volume expansion
    b) Previously normal creatinine raises to =/> 1.5mg/dL
    c) MAP less than 80 mmHg

51. MD to initiate APPENDIX C (either C1 or C2): ALF HEMODYNAMIC MANAGEMENT PROTOCOL
    (Hepatology to check one):
    - **Low Urine Output or Raising Creatinine Management (Appendix C1)** OR
    - **Low Blood Pressure Management (Appendix C2)**
52. Monitor for Hepatic Encephalopathy. Call Hepatology for any of the following (anticipate initiation of APPENDIX D: ALF HEPATIC ENCEPHALOPATHY MANAGEMENT PROTOCOL):
    a) Confusion, drowsiness, asterixis, incoherence, stupor, agitation, unresponsiveness, coma, decerebrate posturing, seizures, or areflexia
    b) Arterial ammonia > 100 mcM/L
    c) MELD score 32 (Hepatology to give score)
53. MD to initiate APPENDIX D: ALF HEPATIC ENCEPHALOPATHY MANAGEMENT PROTOCOL
54. Monitor for "Airway Penetration Risk."
    For *any of the following:* incoherence, stupor, agitation, unresponsiveness, coma, decerebrate posturing, seizures, or areflexia:
    a) Call intensivist on case to intubate patient. "Patient with Fulminant Hepatic Failure and advanced encephalopathy; needs airway protection and ventilator management
    b) After intubation, MD to initiate APPENDIX E: ALF VENTILATOR MANAGEMENT PROTOCOL
55. MD to initiate APPENDIX E: ALF VENTILATOR MANAGEMENT PROTOCOL
56. Monitor for "Intracranial Hypertension High-risk Status." Call Hepatology for (anticipate placement of Intra Cranial Pressure monitor and initiation of APPENDIX F: ALF INTRACRANIAL HYPERTENSION PROTOCOL):
    a) Arterial Ammonia greater than 150 mcM/L
    b) Arterial Ammonia greater that 100 but less than or equal to 150 mcM/L, not decreasing after 24 hours of treatment with lactulose, rifaximin, carnitor, and zinc sulfate
    c) Unresponsiveness, coma, decerebrate posturing, seizures, or areflexia
57. Consult Neurosurgery (Dr. _____) for URGENT placement of epidural intra-cranial pressure monitoring ("Patient with Acute Liver Failure and suspected intracranial hypertension"). Correct coagulopathy (INR< 1.7) before ICP monitor placed by following APPENDIX A if ordered.
58. Call Hepatology for *any of the following* (signs of intracranial hypertension) (anticipate initiation of ALF INTRACRANIAL HYPERTENSION PROTOCOL)
    a) Cushing Reflex: hypertension, bradycardia, and irregular respirations
    b) Pupillary abnormalities (asymmetry or dilation with sluggish response to light)
    c) Decerebrate posturing
    d) Seizure activity or hypertonicity
    e) Intracranial pressure (ICP) greater than or equal to 20 mmHg.

f) Cerebral perfusion pressure (CPP) less than or equal to 50 mmHg after CVP is greater than or equal to 10

59. MD to initiate APPENDIX F: ALF INTRACRANIAL HYPERTENSION PROTOCOL
60. MD to initiate APPENDIX G: ALF THERAPEUTIC HYPOTHERMIA PROTOCOL

APPENDIX A: ALF COAGULATION AND INVASIVE PROCEDURE PROTOCOL

1. For all invasive procedures, the preferred agents for sedation and analgesia are propofol or midazolam with fentanyl.
2. For Invasive Procedures, correct coagulopathy as in order 3, for:
    a. platelets less than 50,000,
    b. INR greater than 1.9 for non-neurosurgical invasive procedure or
    c. INR greater than 1.7 for ICP monitor placement or other neurosurgical procedure, or
    d. fibrinogen less than 150 mg/dL.
3. COAGULATION MANAGEMENT PROTOCOL: give blood products as per "Blood Product Transfusion Protocol" in the following situations:
    - Platelets less than or equal to 10,000: give one unit of single donor platelets per transfusion episode.
    - Platelets less than or equal to 20,000 with petechia, mucosal bleed, or other active bleeding: give one unit of single donor platelets per transfusion episode.
    - Platelets less than 50,000 but more than 20,000 with active bleeding, or needing invasive procedure: give one unit of single donor platelets per transfusion episode.
    - If INR greater than 1.9 for invasive procedure or greater than 1.7 for ICP monitor placement, give _____units of FFP (15 mL/kg body weight; 1 unit = 250-300 mL).
    - Fibrinogen less than 150 mg/dL in patient bleeding or needing an invasive procedure: Infuse 5 units cryoprecipitate. Repeat fibrinogen level. For fibrinogen less than 150 mg/dL, infuse 5 units cryoprecipitate for total of 10 units. Repeat fibrinogen level. Call MD for fibrinogen level less than 150 mg/dL after 10 units cryoprecipitate.
    - If INR still greater than 1.9 for invasive procedure or 1.7 for ICP monitor placement after receiving FFP, call Hepatology for possible consult to transfusion services.
    - Consult transfusion services at 4226 for possible infusion of recombinant factor VII (NovoSeven RT).
    - rVIIa (NovoSeven RT) orders:
      40 mcg/kg IV bolus immediately before invasive procedure.
      Contraindicated in any of the following: Budd-Chairi syndrome, active deep venous thrombosis, pregnancy related liver failure, or in the last 2 weeks the patient has had a myocardial infarction, unstable angina, or a cerebrovascular accident.

APPENDIX B: POTENTIAL HIGHLY INFECTIOUS EXOTIC VIRUS PROTOCOL

(must have order to initiate)

1. Immediately inform nurse managers of Unit F and Unit G of initiation of protocol.
2. Immediately inform the Infection Control Nurse that patient could have a highly infectious exotic virus infection and that advice for special isolation protocols is needed.
3. Only collect selected serology if attending Gastroenterology/Hepatology physician AND attending Infectious Disease physician agree that testing is needed:
   - GI/Liver attending agrees with order #4: ☐ Yes ☐ No
   - Infectious Disease attending agrees with order #4 ☐ Yes ☐ No
4. Order the selected serology below only if order #3 has been completed (physician will choose according to history):
   - **West Africa, or South America's Amazon region:** Yellow fever capture enzyme immunoassay
   - **Congo, Sudan, Uganda, Cote-d'Ivoire, Liberia:** anti-Ebola virus by ELISA
   - **Uganda, Kenya, or Zimbabwe:** anti-Marburg fever IgM-capture by ELISA
   - **Guinea (Conakry), Liberia, Sierra Leone, Nigeria, or other West African countries:** anti-Lassa fever antibodies
   - **Senegal, Kenya, Saudi Arabia, Yemen, Egypt, Tanzania, Somalia, Jordan and Mozambique:** Rift Valley fever antibody (ELISA)

APPENDIX C1: ALF HEMODYNAMIC MANAGEMENT PROTOCOL
LOW URINE OUTPUT OR RAISING CREATININE MANAGEMENT:
(must have order to initiate and specific orders must be checked)

- When giving Norepinephrine, the MAP goal for your patient is 85 mmHg (previous normal creatinine or hypertensive before ALF)

OR

- When giving Norepinephrine, the MAP goal for your patient is 75 mmHg and to reach the previous baseline creatinine goal of _____mg/dL (previously elevated creatinine before ALF)

Once Goal established:

- Do not start norepinephrine drip until CVP is equal to or more than 10.
- Start norepinephrine drip at 0.1 mcg/kg/min and titrate to achieve MAP goal ordered (dose range = 0.01-3 mcg/kg/min).
- **DO NOT** discontinue norepinephrine unless instructed by Hepatology.
- When 3 mcg/kg/min (max dose) of norepinephrine and MAP remains less than goal ordered, call Hepatology with possibility of changing to the LOW BLOOD PRESSURE MANAGEMENT protocol (anticipate adding vasopressin or phenylephrine drip).
- When MAP goal reached and urine output does not increase to =/> 50 ml/hour for 4 hours, call Hepatology (anticipate nephrology consult and possible SLED).
- Consult nephrology for SLED (without heparin).
- Shiley catheter to be placed by _____. Correct coagulopathy (if applicable) using APPENDIX A: COAGULOPATHY AND INVASIVE PROCEDURE PROTOCOL before procedure.

APPENDIX C2: ALF HEMODYNAMIC MANAGEMENT PROTOCOL
LOW BLOOD PRESSURE MANAGEMENT:
(must have order to initiate and orders must be checked)

- When giving pressors, MAP goal for patient is 75 mmHg (patient previously normotensive)

OR

- When giving pressors, MAP goal for patient is 85 mmHg (patient previously hypertensive)

OR

- Patient is having hepatorenal syndrome or low urine output. Goal MAP for this patient is 85 mmHg, creatinine goal of less/equal to 1.5 mg/dL, and urine output greater than 50 mL/hour.

Once goal established:

- Do not start norepinephrine or other pressor drip until CVP equal to or greater than 10.
- Start norepinephrine drip at 0.1 mcg/kg/min and titrate (.01-3 mcg/kg/min) to achieve MAP goal. Call Hepatology if max dose of norepinephrine (3 mcg/kg/min) does not achieve MAP goal (anticipate vasopressin or phenylephrine drip); **MUST call Hepatology for order to start additional pressor.**
- Start vasopressin drip at 1 international unit/hour and titrate (0.6 - 4 international units/hour) to achieve MAP goal or creatinine and urine output goal.
- Start phenylephrine drip at 1.4 mc/kg/min and titrate (0.4-9.1 mcg/kg/min) to achieve MAP goal or creatinine and urine output goal.
- Transplant surgery or intensivist to place arterial-line if second pressor started.
- Call Hepatology when max doses of norepinephrine, vasopressin and phenylephrine are reached without achieving MAP goal (anticipate dopamine drip and cortrosyn stimulation test); **MUST call Hepatology for order to start additional pressor.**
- Place SvO2 capable swan ganz catheter or ScvO2 capable triple lumen catheter if not already present (anticipate if on two pressors).
- Call Hepatology for cardiac index less than 3.5 L/min/m2 (anticipate dopamine drip)
- After goal MAP has been achieved, call Hepatology for SvO2 less than 65% or ScvO2 less than 70%. Anticipate blood transfusion for low hematocrit less than 30%, or dopamine drip if not currently on.
- Call Hepatology for hematocrit less than 30% on pressors.
- Start Dopamine drip at 5 mcg/kg/min and titrate as needed to achieve MAP goal, creatinine less than or equal to 1.5, and urine output more than 50 mL/hour. Call Hepatology when goal MAP not reached (anticipate Infectious Diseases consult for broad spectrum antibiotics/antifungals and treatment for Adrenal Insufficiency).
- Cortrosyn Stimulation test (anticipate if on max doses of two pressors)(do the following):
    -Obtain basal serum cortisol (and free-cortisol if albumin =/< 2.5 g/dL)

-Give Cortrosyn 250 mcg bolus IV
-At 30 and 60 minutes post Cortrosyn, draw post stimulation serum cortisol and free-cortisol (if albumin =/< 2.5 g/dL) levels
-Call results to Hepatology

- Adrenal Insufficiency Orders: (do the following)
  -Start Hydrocortisone 100 mg IV every 8 hours
  -Order serum aldosterone level to be tested on the basal and post stimulation serum samples
- Infectious Disease, Dr._____ to see patient for broad spectrum antibiotic and antifungal therapy: Refractory hypotension in patient with acute liver failure; please give anti-bacterial and anti-fungal coverage

APPENDIX D: ALF HEPATIC ENCEPHALOPATHY MANAGEMENT (must be ordered to initiate)

- Lactulose 30 cc every hour until first BM, then 15-60 cc every 4-8 hours to produce 4 bowel movements a day or stool output of 600-700 mL/day. Discontinue Lactulose once the patient is listed for Liver Transplant.
- Rifaximin 400mg PO/FT every 8 hours
- Carnitor 1320 mg PO/FT every 8 hours. Discontinue Carnitor if seizures occur.
- Zinc Sulfate 220 mg PO/FT once a day
- Call Hepatology for *any of the following (anticipate tracheal intubation and activation of* APPENDIX E: ALF VENTILATOR MANAGEMENT PROTOCOL):
    a) incoherence
    b) stupor
    c) agitation
    d) unresponsiveness
    e) coma
    f) decerebrate posturing
    g) seizures
    h) areflexia
- For patient intubated (intensivist to intubate), follow APPENDIX E: ALF VENTILATOR MANAGEMENT PROTOCOL (MD to initiate).

APPENDIX E: ALF VENTILATOR MANAGEMENT PROTOCOL

- Once intubated, sedate with Propofol IV, starting dose of 5 mcg/kg/min, may titrate for sedation. Do not exceed 50 mcg/kg/min without specific MD order which allows up to 80 mcg/kg/min.
- Intensivist to manage ventilator.
  Strongly consider the following:
  - Limit tidal volume to </= 6 ml/kg of "predicted body weight"
  - Limit plateau pressure to < 30 cm H_20
  - Increase respiratory rate to keep PCO_2 30-40 mmHg
  - Avoid/minimize PEEP to minimize intracranial pressure
- Once intubated:
  - Keep head of bed elevated 30 degrees at all times, unless CPP below 50 mmHg
  - Avoid sudden head movements
  - Give endotracheal lidocaine for suction
  - Keep room quiet
  - Do only indispensable interventions

APPENDIX F: ALF INTRACRANIAL HYPERTENSION PROTOCOL
(must have order to initiate)
Goal: ICP < 20 mmHg and CPP > 50mmHg

- Monitor ICP and CPP hourly
- For CPP below 50 mmHg, flatten bed to zero degrees, until CPP > 50 mmHg
- Daily EEG. Notify Hepatology or neurology (if consulted) of EEG results.
- For patient who develops seen seizure activity, give Ativan 1mg over 2 minutes, may repeat 1mg every 3 minutes if needed; do not exceed 4 mg total. Call Hepatology (anticipate neurology consult).
- Keppra 1gm in 0.9% NaCl IV over 15 minutes for seen seizures or seizures seen only on EEG.
- Consult Neurology, Dr. _____to manage seizures.
- For urine output greater than or equal to 30 mL/hour, check plasma osmolarity stat; for osmolarity 305 or less, give 0.5gm/kg Mannitol IV over 15 minutes .
- Give 0.5 gm/kg Mannitol IV over 15 minutes every 4 hours for osmolarity less than 310 mOsm/L. Repeat osmolarity one hour prior to Mannitol dose due. Hold dose for osmolarity greater then 310 mOsm/L.
- Call Hepatology for urine output less than 30 mL/hour for possible nephrology consult and SLED.
- Consult Nephrology, Dr._____ for SLED (no heparin).
- Continue to check osmolarity and give Mannitol if appropriate while on SLED.
- While on SLED and receiving Mannitol, remove 3-5 times the volume of Mannitol given in each dose (discuss with nephrology).
- For ICP greater than 20 mmHg and CPP less than 50 mmHg despite Mannitol treatment, call Hepatology (anticipate initiation of Therapeutic Hypothermia Protocol).
- MD to initiate APPENDIX F: ALF THERAPEUTIC HYPOTHERMIA PROTOCOL

APPENDIX G: ALF THERAPEUTIC HYPOTHERMIA PROTOCOL
(must have order to initiate)
Protocol used only for ICP greater than 20 refractory to Mannitol or with contraindication to Mannitol

- ❑ Neupogen 300 mcg SQ x 1 dose
- ❑ Strict NPO, stop enteral feedings, D/C any PO/NGT/NJT medications. Call Hepatology for order changes to routes of oral medications.
- ❑ IV fluids: D10NS 1000 ml at 85 ml/hr; add 1vial MVI + 1 amp trace elements + 100 mg Thiamine + 500 mg Vitamin C once a day.
- ❑ Insert Foley catheter with temperature probe to monitor hypothermia.
- ❑ Obtain baseline (before hypothermia):
    a) ABG (analyzed at actual body temperature)
    b) Troponin
    c) CK-MB
    d) Lactate
    e) CMP
    f) Magnesium
    g) Ionized calcium
    h) Phosphorus
- ❑ 12 lead EKG (document QT interval) at baseline and every 8 hours while in hypothermia.
- ❑ Hypothermia induction (not to exceed 48 hours of cooling):
    A. **Arctic Sun Device:** Select the correct "pad size" according to weight and height of patient. Document "Arctic Sun" water temperature every hour during maintenance. Do not use ice packs or cooling blanket. Follow machines attached instructions to automatically cool to 33 degrees C (automatically over 6-8 hours). Maintain temperature for 36- 48 hours.
    B. **Cooling blanket/ice packs/IV saline:** Achieve goal temperature of 33 degrees C (range 32-34 degrees C) over 6- 8 hours; place cooling blanket under the patient and on top of the patient (place a sheet between the patient's skin and cooling blankets to protect the skin); administer 20 mL/kg bolus of refrigerated "normal saline" over 30 minutes through a <u>peripheral</u> IV line; maintain temperature for 36-48 hours.
- ❑ Document temperature every 15 minutes during cooling initiation and re-warming. Document temperature every hour during maintenance. Accurately document when the patient's temperature drops below 34 degrees C.
- ❑ Monitor for shivering with every vital sign check.
- ❑ Monitor skin integrity with every 2 hour checks; wrap hand and feet in dry towel to prevent frostbite, while in hypothermia.
- ❑ During initiation and re-warming of hypothermia obtain BMP, magnesium, ionized calcium, and phosphorus every hour.

- During maintenance of hypothermia obtain BMP, magnesium, ionized calcium, and phosphorus every 4 hours.
- At 12 and 36 hours after initiation of cooling obtain troponin, CK-MB, lactate, and CBC with diff.
- Dysrhythmia Prophylaxis: Amiodarone 150 mg IVPB over 10 minutes, then 1 mg/min for 6 hours, then 0.5 mg/min.
- Seizure Prophylaxis: Keppra 1 gm in 0.9% NaCl IV over 15 minutes. Repeat every 12 hours. Ask pharmacy to adjust dose according to renal function.
- Pain Prophylaxis: Fentanyl infusion IV (2500 mcg/250 mL NS): bolus of 100 mcg IV push, then continue with infusion at 1-2 mcg/kg/hour and titrate as needed.
- Propofol IV drip at 5 mcg/kg/min and titrate for sedation. Do not exceed 50 mcg/kg/min without specific MD order which allows up to 80 mcg/kg/min.
- Shivering Prophylaxis:
    a) Cisatracurium (Nimbex): Bolus 0.15 mg/kg IV push over 10 seconds (5 ml of the 2 mg/ml cisatracurium injection-solution for an average 70 kg person), then give:
    b) Maintenance infusion: watch first for early evidence of spontaneous recovery from the initial bolus and then give cisatracurium infusion (200mg/500ml 0.9% NaCL) starting at 3 mcg/kg/min; titrate by 1 mcg/kg/min down or up to provide adequate neuromuscular block (for an average sized 70 kg patient, at this concentration of 0.4mg/ml, the initial infusion rate would be about 30 ml/hour, and then titration will be done with decrements or increments of 10 ml/hr as needed). Discard cisatracurium infusion-solution after 24 hours at room temperature, and replace with fresh one. Ensure adequate sedation and analgesia prior to cisatracurium inititation. Initiate "Train of Four (TOF)" monitoring. Get baseline. Goal is 4 stimulations/1-2 twitches.
- Re-warming: After 36 hours of maintenance cooling, begin "passive re-warming" at 0.25 to 0.33 degrees C per hour (no faster than 0.5 degrees C per hour) to achieve temperature of 36 degrees C ideally over 8-12 hours. Remove cooling blankets and ice packs. Maintain paralytics, sedation, and analgesics until temperature of 36 degrees C is achieved. Then remove paralytics and wait until complete recovery from neuromuscular block, and then wean fentanyl and propofol as appropriate. If temperature is not greater than/= 36 degrees C after 12 hours, initiate active re-warming with "warm blanket." After temperature is 36 degrees C, ask primary team if keppra and amiodarone are still needed.
- For ICP greater than 20 mmHg and CPP less than 50 mmHg with mannitol and hypothermia treatment call Hepatology (anticipate Thiopental drip).
- Thiopental drip 5 mg/kg IV over 15 minutes followed by 3 mg/kg/hour infusion. Ask Neurology, Dr._____ to monitor coma and regulate Thiopental dose by EEG and ICP/CPP response.

- Call Hepatology for ICP greater than 20 mmHg and CPP less than 50 mmHg with Thiopental drip (anticipate Indomethacin order).
- Indomethacin 25 mg PO/FT x 1 dose.

APPENDIX H: ALF Abdominal Hypertension Protocol

Goal: 1. Intra-abdominal Pressure (IAP) </= 15 mmHg, and
2. Abdominal Perfusion Pressure (APP) = MAP-IAP >/= 60 mmHg

1. Remove any constrictive garments over the abdomen.
2. Do not cover patient with heavy blankets or covers; if needed, use air-warming/cooling blanket to keep temperature of 36.5 ^{0}C
3. Keep the bed straight at all times (do not bend in abdomen). If 30^0 head elevation is needed, do it by Reverse Trendelemburg with straight bed (do not bend in abdominal area).
4. Place NGT and keep under low-intermittent suction.
5. Place fecal management system or rectal tube, to decompress colon, to gravity drain.
6. Discontinue Lactulose.
7. Erythromycin 125 mg IV q 6 hours.
8. Obtain abdominal ultrasound to look for ascites or other fluid collections; if present ask radiology to drain them.
9. Inform Transplant Surgery that patient has intra-abdominal hypertension.
10. If Abdominal Perfusion Pressure remains below 60 mmHg, and MAP is < 85 mmHg, call Hepatology for orders to raise blood pressure (anticipate use of "ALF Low Blood Pressure Protocol").
11. If pressure and perfusion goal is not reached with orders 1 through 8, discontinue enteral feeding.
12. After 4 hours from discontinuation of lactulose, obtain Acute Abdominal Series X-Ray: "Evaluate for colonic and/or gastric distention". If colon or stomach is distended, call Hepatology to decide if endoscopic decompression or neostigmine is indicated.