Enhanced Recovery after Surgery (ERAS) Pathway
Open and Laparoscopic Liver Resection

**DAY of SURGERY**

1. Carbohydrate drink: Given to patient by preop screening to drink 1 hour before scheduled arrival time.

**DAY of SURGERY, PREOP HOLDING**

1. Preop nursing staff will
   a. IDENTIFY ERAS patient and initiate protocol
   b. DOCUMENT if carbohydrate drink was taken and document time

2. Reinforce expectations and review education of the patient about expectations for pain and pain control.
   a. **Expectation:** Pain of 2-3/10 is expected and reasonable.
   b. **Expectation:** Pain of 5/10 would be the point to ask for additional medication (if patient were at home – they would self-treat at a 5/10)
   c. **Expectation:** May have ‘bloated’ sensation if laparoscopic procedure (this is residual from insufflation – normal and resolves over 12 hours or less without treatment)
   d. **Education:** Pt may experience referred shoulder pain due to irritation of CO2 bubble under diaphragm. Walking or changing positions will relieve this “aching pain”. Inform patient this will feel like an “over-use or strain” type of an ache. This resolves again over 12 hours or less.

3. Multimodal analgesia and anti-emetics to be given by preop RNs, confirmed by Anesthesiologist
   a. Multimodal analgesia
      i. **Celecoxib** 200 mg PO
   b. PONV prophylaxis for high-risk patients (one of the following - history of PONV or motion sickness, female < 50 years)
      i. **Scopolamine** patch if < 65 years
      ii. **Aprepitant** (Emend) for > 65 years or history of failed scopolamine patch

4. Mid thoracic epidural (most patients, if epidural pathway, see below)

**INTRAOPERATIVE**

1. **VTE PROPHYLAXIS**
   a. **Heparin** 5000u SC given after induction and before incision. There is no need to wait following epidural placement according to current ASRA guidelines.
   b. **SCDs**

2. **MULTIMODAL ANALGESIA:** Epidural vs Non-Epidural Pathway will generally be selected in surgery clinic based on joint surgery/anesthesia criteria. Clinical judgement of anesthesiologist on day of surgery may result in change of plan (please remember to discuss with surgeon), but the goal is for this to be rare. Relative contraindications include extended resections or pre-existing liver failure with increased chance of postoperative coagulopathy, but these are rare.
a. **EPIDURAL PATHWAY:** (open cases, larger laparoscopic cases or history of chronic pain; this will be used for majority of cases)
   
   i. **Thoracic epidural** at T7-9 (placed in preop or in OR)
      
      1. Pre-incision epidural bolus of lidocaine 2% 2-5mL (40-100mg) recommended if open procedure
      2. Run epidural bupivacaine 0.0625%/hydromorphone 10mcg/mL throughout case (3-6 mL/hr) as tolerated
   
   ii. Goal is to minimize IV opioids during case. Prefer using epidural bolus if clinically indicated. Do not administer IV opioids without first discussing with attending anesthesiologist.
   
   iii. However, if patient is chronic opioid user, replace baseline opioid requirement (discuss specifics with attending anesthesiologist).
   
   iv. **Ask surgeon about Acetaminophen** 1g IV at closing for smaller resections- the majority of cases will NOT get Acetaminophen
   
   v. For chronic pain patients, consider adding pre-incision IV ketamine 0.25-0.5mg/kg and infusion 4mcg/kg/min during surgery (based on ideal body weight)

b. **NON-EPIDURAL PATHWAY:** (smaller laparoscopic resections or thoracic epidural contraindicated, this will be used for minority of cases)
   
   i. **Surgeon will infiltrate with local anesthetic** while closing (consider Exparel) OR consider truncal block (TAP or QL) preoperatively.
   
   ii. **Ketamine** 0.25-0.5mg/kg and infusion 4mcg/kg/min during surgery (based on ideal body weight). Consider reducing or holding in elderly
   
   iii. **Magnesium** 2g IV (if ESRD or Cr >2, consider 1g)
   
   iv. **Lidocaine** infusion 1mg/kg/hr IV intraoperative (shut off prior to giving Exparel)
   
   v. Goal is to minimize IV opioids during case. Do not administer IV opioids without first discussing with attending anesthesiologist.
   
   vi. However, if patient is chronic opioid user, replace baseline opioid requirement (discuss specifics with attending anesthesiologist).
   
   vii. **Ask surgeon about Acetaminophen** 1g IV at closing for smaller resections– the majority of cases will NOT get Acetaminophen

3. **ANTIBIOTIC PROPHYLAXIS**
   
   a. First line – **Cefazolin** 2g IV (3g if >120kg) (redose 4hrs). Add metronidazole 500mg IV if biliary involvement. Discuss with surgeon (no redose).
   
   b. Second line – Clindamycin 900mg IV (redose 6 hrs) + ciprofloxacin 400mg IV (no redose).

4. **GASTRIC TUBE** – orogastric tube to be removed at the end of surgery

5. **PONV prophylaxis** – **Dexamethasone** 4mg IV at start of case, **Zofran** 4mg IV when closing

6. **FLUID THERAPY**
   
   Part 1 - until liver specimen removed – run the patient ‘dry’
   
   a. LR infusion 2-3mL/kg/hr based on ideal body weight.
   
   b. Goal is to run the patient ‘dry’ with permissive hypovolemia. Albumin to replace blood loss 1:1 if hypotensive. Phenylephrine infusion, or other vasopressor can be used as needed.
Part 2 - once liver specimen removed – optimize with Goal Directed Fluid Therapy

a. LR infusion 3mL/kg/hr. based on ideal body weight for maintenance IVF
b. Goal Directed Fluid Therapy (GDFT) with boluses of fluid to optimize SV using a CO monitor (Retia if using a-line or Cheetah if not using a-line)
   - Record stroke volume (SV)
   - Give a 250ml fluid bolus over <15 min (can omit if PVV/SVV < 10%)
   - If SV increases by >10 % repeat bolus
   - If SV increases by < 10% patient does not require a further bolus
   - Record peak value achieved
   - If still hypotensive, consider phenylephrine bolus or infusion
   - Give a further fluid bolus when SV drops 10% from peak value
   - Repeat cycle

7. URINARY CATHETER – Remains in place at end of surgery

8. TRANSFUSION – Please keep surgeons informed if transfusion is needed

9. VENTILATION
   a. Low-flow anesthesia at flows ≤ 1 L/min
   b. Maintain TV 6-8 mL/kg (ideal body weight)
   c. Minimize FiO2 (30-40%) to minimize atelectasis
   d. Maintain adequate PEEP relative to the patient’s body habitus and pulmonary status
   e. Consider increasing PEEP prior to insufflation or Trendelenburg position if used for the procedure
   f. Trend compliance and consider alveolar recruitment when compliance trends downward
   g. Following any recruitment maneuver, maintain adequate PEEP to minimize atelectasis

10. NEUROMUSCULAR BLOCKADE & REVERSAL
    a. Quantitative TOF monitoring should be used. If quantitative TOF monitor is not available, a
       peripheral nerve stimulator on the ulnar nerve should be substituted. The facial nerve is relatively
       resistant to neuromuscular blockade and should not be relied upon for reversal dosing or assessing
       adequacy of reversal.
    b. Reversal with sugammadex should be standard. Refer to the chart attached to the side of your
       anesthesia machine for dosing guidelines.

PACU

1. If epidural, PACU RNs will preferentially treat pain with RN-administered epidural boluses from the pump
   instead of using IV opioids as first-line. This is in the epidural order-set.
2. PRN narcotics should still be ordered - RNs will use as second-line strategy for pain management for patients
   with epidural.
3. For chronic pain patients, continue replacing baseline opioid requirement & consider ketamine infusion.

Revision History:
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