



Guidelines for Anaesthesia for Hepatobiliary Surgery GSH and UCTPAH (2021)

Thoracic epidural indicated for:

- Major Open Liver Resection
- Complex Minor Open Resection with posterior or central position
 - +/-redo Sx
 - +/-Portal Hypertn
 - +/-IVC involvement
 - +/-biliary enteric anastomosis
- Comorbidities

Standard requirements:

- Arterial line + CVP + large bore vascular access
- Underbody forced air warmer
- Urinary catheter
- NO NGT

If complex major OLR ADD:

- CO monitor (EV 1000)
- Cell saver +/- venovenous bypass
- Sheath + high flow blood transfusion device

Intraoperative:

1. TEA established prior to incision
2. Boluses/infusion to maintain level TWO dermatomes above incision

High care:

1. TEA infusion for 48-72hr
2. Stepwise supplementation of analgesia
3. Start oral Tramadol on discharge to ward
4. Transition to PCA if needed

Note:

1. Bupivacaine + morphine TEA infusion gives 12-24hr added analgesia after epidural removal
2. We avoid paracetamol and NSAIDs in major resections



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Thoracic Epidural Analgesia Alternative

ITM/ Dex./ IV lignocaine/ AWC indicated for:

- Minor open liver resection (< 3 segments)
- Laparoscopic liver resection
- Major/ minor complex resection if TEA not feasible

Standard requirements:

- Arterial line + large bore vascular access
- Underbody forced air warmer
- Urinary catheter
- NO NGT

LOW RESOURCE SETTING

Substitute ITM with 40-% standard morphine dose. To ward with fentanyl PCA postop.

Laparoscopic:

1. ITM at start
2. IV lignocaine + dexmedetomidine continued into high care
3. LA to port sites
4. Tramadol + Paracetamol + NSAIDs

Open:

1. As for laparoscopic
2. Stop IV lignocaine 30min prior to end
3. Add AWC + bolus 0.25% bupivacaine
4. AWC bupivacaine infusion postop. for 72 hours

High Care:

1. Stepwise supplementation of analgesia
2. Tramadol/ Tapentadol
3. Rescue morphine boluses
4. Paracetamol + NSAIDs
Fentanyl PCA Day 0 or
5. Fentanyl/Morphine PCA at discharge to ward



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Pancreaticoduodenectomy guidelines

Standard requirements:

- Large bore intravenous access
- Second peripheral line with clamp
- Underbody forced air warmer + urinary catheter
- NGT + NJ feeding tube at bowel anastomosis
- CVP as appropriate

Analgesia:

- TEA or ITM/ IV lignocaine/ IV ketamine + AWC
- Dex. may be used but not required to lower CVP in Whipples
- Substitute ketamine unless contra-indicated (+ continue into high care)
- AWC – continued for 72 hours

Postoperatively:

- Stepwise supplementation of analgesia
- IV Paracetamol
- Rescue morphine boluses
- Transition to fentanyl/morphine PCA or ketamine + fentanyl/morphine PCA on discharge to ward

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Section A.Guidelines for Anaesthesia for Hepatobiliary Surgery GSH and UCTPAH (2021)

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(see attached notes for details)

Guideline 1.

TEA - thoracic epidural analgesia

Used for

Major Open Liver resection

Complex Minor Resection

ie with posterior or central position +/-redo SX+/-Portal Hyptn +/-IVC involvement +/-biliary enteric anastomosis

Comorbidities

ie COAD where TEA is indicated for comorbidity management intra/ and or postop

Baseline

Aline

CVP + large bore vascular access

Underbody warming device

Urinary catheter

Prophylactic antibiotics, repeated at 4 hours

Working epidural (TEA) established prior to incision with bupivacaine.

Bupivacaine 0.25% boluses or infusion intraoperatively to maintain level 2 dermatomes above incision.

Fluid restriction plus epidural induced splanchnic and peripheral vasodilation lower CVP until liver resected.

Complex Major OLR

Add

Peripheral CO monitor (EV1000)

Cell saver +/- filter for cancer cases +/-Venovenous bypass.

Consider sheath and high-flow ranger blood transfusion and warming device

Postoperative High Care Unit

Bupivacaine 0.1%/opiate infusion into high care for 48 -72 hours as per epidural protocol

Supplement analgesia as appropriate in a stepwise manner only if required to enhance analgesia

Start oral analgesia

-Tramadol or tapentadol (oral) on day of discharge to ward (Postop Day 2 or 3)

-Transition to fentanyl or morphine PCA if needed

Consider paracetamol and NSAIDS

Note

1.bupivacaine /morphine infusion allows morphine to accumulate with 12 – 24 hrs added analgesia on removal of TEA.

2.We avoid paracetamol and NSAIDS in major resections and complex minor resections.

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Guideline 2.

TEA alternative -Thoracic epidural alternative.

Minor liver resection (<3 segments)

Minor open liver resection

Laparoscopic liver resection

(Major or complex minor resection if TEA not possible/feasible)

Baseline

Aline

Good vascular access

Underbody warming device

Prophylactic antibiotics, repeated at 4 hours

(CVP not required)

Fluid restriction plus use of adjuvants lowers CVP as appropriate until liver is resected.

Laparoscopic .

Intrathecal morphine (ITM) at start of procedure

IV lignocaine and IV dexmedetomidine started prior to incision and continued into high care for up to 24 hours.

Local bupivacaine at port sites. (*Consider lignocaine dose in calculating dose)

Postoperative High Care

Oral analgesics started in a stepwise manner as needed

Tramadol, Paracetamol, NSAIDS as appropriate

Note: if laparoscopic becomes open continue as below.

Open.

Stop IV lignocaine half an hour prior to end of procedure.

Add wound infusion catheters placed at end of surgery. 0.25% bupivacaine bolus. (*Consider lignocaine dose in calculating dose)

Continue with bupivacaine infusion via abdominal wound infusion catheter (AWC) for up to 72 hours postop.

Supplement analgesia as appropriate in a stepwise manner with

-Tramadol or tapentadol (oral)

-Morphine boluses for rescue only (Minimise systemic opiate use)

Add paracetamol, NSAIDS as appropriate.

Day 0 -consider fentanyl PCA OR

Day 1 (24 hours post spinal morphine)– Fentanyl PCA or morphine PCA (+/- ketamine) added as needed to transition to ward.

Note :

1.We avoid paracetamol and NSAIDS in major and complex minor resections. Avoid NSAIDS where contraindicated in minor resections.

2.Monitor for 24 hours in high care for respiratory depression. (ITM)

In a resource limited setting

-without availability of high care beds omit ITM. Use IV morphine at +/- 40% of expected dose as adjuvants reduce requirements. AWC plus fentanyl PCA to ward

-If wound infusion catheters are not available epidural catheters can be used as a wound infusion catheter with an electronic infusion pump attached. One into posterior rectus sheath and one into TAP space.

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Guideline 3.

Hepaticopancreoduodenectomy guidelines

- Large bore IV access- 14 to 16 g
- second peripheral line with clave (if no CVP) for drug infusions (ketamine, lignocaine, phenylephrine)
- no CVP – sited if required intraoperatively due to excessive blood loss/SIRS/sepsis/inotrope requirements
- underbody warmer
- urinary catheter
- Prophylactic antibiotics, repeated at 4 hours (if instrumentation of biliary tree tailor to previous culture results)
- NGT plus nasojunal feeding tube at bowel anastomosis

Analgesia

TEA

or

ITM/ IV lignocaine /IV ketamine + AWC (TEA alternative with dex substituted for ketamine)

- Dexmedetomidine may be used but is not required for its CVP lowering properties in Whipples Procedures.
- Substitute ketamine instead. Bolus 0.2mg/kg then Infusion of 0.2mg/kg/hr intraop. (Concentration of 2mg/ml of ketamine at 0.1ml/kg/hr.)
- Continue wound infusion catheters for 72 hours
- Continue IV ketamine into high care at half intraop infusion rate. (0.1-0.2 mg/kg/hr.)

Supplement analgesia as appropriate in a stepwise manner only if required to enhance analgesia

-Paracetamol (IV)

-Add morphine boluses prn

Transition to fentanyl+/- ketamine PCA or morphine+/-ketamine PCA

For ITM -Day 1 postoperatively

For TEA- On day of discharge from High care when epidural removed.

*Local anaesthetic toxicity

Bupivacaine and lignocaine toxicity is additive.

Generally, no more than the maximum dose, over the half-life of the drug, should be given.

Bupivacaine 2mg/kg/4 hr

Lignocaine 3mg/kg /100 minutes

Initially lignocaine infusions rates were routinely run at 3mg/kg/hr. Recent pharmacokinetic work shows metabolism becomes nonlinear after 12 hours of infusion, and doses of infusion should not exceed 1.5mg/kg/hr for 24 hours. This dose is unlikely to lead to toxic levels of >5ug/ml over 24 hours.

We run our infusion at 1mg/kg/hour for up to 24 hours for laparoscopic work if high care monitoring is available. For open surgery we stop the IV lignocaine half an hour prior to emergence and bolus our wound infusion catheters with 1mg/kg bupivacaine. (20-30mls of 0.25% bupivacaine to stay within toxicity guidelines.) before starting a bupivacaine infusion.

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B. Notes on Guidelines for Anaesthesia for Hepatobiliary Surgery GSH and UCTPAH (2021)

Notes on Guideline 1

TEA - thoracic epidural analgesia

(see note below on how to make an epidural work)

Aim: To pre-emptively establish a functioning epidural prior to incision , maintaining a level 2 dermatomes above incision level intraoperatively and seamlessly continuing this into the high care for 2-3 days maintaining splanchnic perfusion protection for the early period of liver regeneration.

Intraoperatively

Fluid restriction plus epidural splanchnic and peripheral vasodilation lowers CVP and achieves portocaval decompression until the liver resected.

Map can drop by 30% without lowering O2 supply. HR 60 with MAP 60 are ideal for liver resection. But individualize according to patient.

Support MAP with IV low dose phenylephrine (low MAP with high HR) or ephedrine (low MAP with low HR) as indicated.

Return to normovolaemia once haemostasis is achieved. Some centres start GDFT (CO monitoring) at this point and continue into high care.

Postoperative

Fluid management

- GMS IVI at 1.2mls/kg/hr
- Rehydration 1 litre IVI over 24 hours
- Voluven ,volulyte or balsol boluses 200 mls prn to maintain urine at 0.3 to 0.5mls/kg/hr or MAP > 60mmHg
(i.e. in response to any indicator of increasing fluid requirements)

Note

GDFT goal directed fluid therapy IE: SVV with peripheral COO monitoring may be best but often not available.(studies inconclusive)

The liver needs to regenerate and increases cardiac output to do so . The first 48-72 hours postoperatively are critical for liver regeneration. We need to facilitate this. A restrictive fluid policy is not advised.

Most patients can tolerate free fluids orally from 4 hrs postop and progress to FWD as tolerated.

Epidural management

Always add an opiate to bupivacaine postoperatively (morphine or fentanyl unless contraindicated) to prevent tachyphylaxis and increasing requirements of local anaesthetic.(see epidural notes)

Epidural protocol to maintain desired sensory level and monitor for epidural haematoma.

Maintain level 2 dermatomes above incision with infusion plus top-up boluses as required.

We monitor epidural level hourly for 3-4 hours to adjust infusion rate early to maintain desired level. Then 4hrly.

Monitor hourly for return of motor power and then 4hrly once power has returned.

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Notes on Guideline 2

TEA Alternative Strategy

Aim : to emulate the positive analgesic (ITM morphine, DEX, lignocaine) **/CVP lowering** (DEX +fluid restriction)/ **stress reducing /immunomodulating effects of TEA** (DEX + lignocaine)

Technique:

-No NGT required

-Aline

-CVP not routine

- CVP required for hepatectomy / extended hepatectomy/ segmentectomies complicated by central position, proximity to major vessels, redo surgery, portal hypertension, previous biliary tree instrumentation (risk of sepsis) biliary enteric anastomosis as in addition to monitoring central venous pressures line insertion may be required for access and inotropic support as well
- CVP usually not required in laparoscopic resections or simple minor resections.
- SVV can be used as a surrogate for CVP .This will require a peripheral Cardiac output monitor attached to the Aline without CVP. **Useful** for Goal Directed Fluid Therapy (GDFT). **Indicated** in major complex open liver resection (OLR) if available.

Fluid restriction to facilitate low CVP until liver is resected and haemostasis is achieved.

Anaesthesia:

- Large bore IV access- 14 to 16 g
- Second peripheral line with clave (if no CVP) for drug infusions (dexmedetomidine, lignocaine, phenylephrine)
- Spinal morphine (150 ug -250ug) thought to be optimal for most intrabdominal surgery (mix in saline about 1.5 -2.0 mls)
- Consider addition of 3-4mls plain bupivacaine if haemodynamics and anticipated length of surgery allow (i.e. 3-4 hours)

Note

This plain bupivacaine has a slow onset so is generally haemodynamically stable

Volume must be adequate to cover the upper abdominal incision

This does not prohibit use of IVI lignocaine

- dexmedetomidine (4 ug / ml) at 0.1 - 0.5 ug/kg/hr titrated to effect (slow HR (60)and BP control- (MAP 60) may require bolus up to 0.5 ug/kg at start to achieve this. (Do not use 1ug/kg bolus loading dose or infusion as this can cause hypertension and bradycardia probably due to vasoconstriction due to stimulation of the α_2B receptor.)
- lignocaine 1.5mg/kg over 10 minutes then 1mg/kg/hr until 30 minutes prior to end of surgery.
- IV fentanyl 200 to 400 ug over course of surgery (or morphine early on -generally 40% of usual anticipated dose.)

Note

Analgesic requirements intraoperatively are reduced by up to 50% by IV dexmedetomidine and IV lignocaine use

Spinal morphine gives good postoperative analgesia (12-24 hrs) but is often not adequate for surgical analgesia intraoperatively.

Risk of respiratory depression with spinal morphine 0.3-3%

There is an increased chance of respiratory depression with parenteral opiates /sedatives plus spinal morphine



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Postoperatively

- Single wound infusion catheter 12.5 cm /18.5cm .0.2% bupivacaine usually appropriate (double catheter if midline incision with 0.2% bupivacaine as 2 catheters at 5mls / hr each required or 8ml/hr with splitter.)
- Continue dexmedetomidine into high care at 0.1 - 0.3ug/kg /hr
- Supplement analgesia as appropriate in a stepwise manner only if required to enhance analgesia
- Tramadol or Tapentadol (oral)
- Add morphine boluses prn
- As appropriate
 - Paracetamol (IV or oral)
 - NSAIDS (IV or oral)
- Fentanyl PCA s are useful instead of morphine boluses but are usually not practical until Day 1 to transition to ward.

Monitor for respiratory depression for 24 hours.

- Respiratory rate and level of consciousness hourly x12 hours then 2 hourly x 12 hours (ASA guidelines)
- We monitor pulse oximetry. ABG analysis for CO₂ monitoring if indicated.

Note

1.NSAIDS and paracetamol are recommended in the literature for analgesia in liver resection and will be introduced as part of ERAS where appropriate.(Prospect trial, ERAS guidelines)

Use of both of these analgesics is dependent upon the amount of liver resected and the general state of the liver (underlying cirrhosis, fatty liver, recent chemotherapy, presence of ischaemic insult) and on comorbidities.

All NSAIDS are contraindicated :Elderly, peptic ulcer disease and gastritis, hypertension and cardiovascular disease , renal insufficiency

Caution perioperatively in patients at risk of AKI and stress ulceration.

Cox 2 inhibitors are contraindicated in : IHD , stroke , renal Impairment

Caution in :Hypertension , hyperlipidaemia, diabetes, peripheral artery disease , current smoking

Recommendations -lowest dose for shortest time available (<5 days perioperatively)

2.Respiratory depression

Risk factor for respiratory depression ITM	
Pharmacological	Higher dose Concomitant administration of systemic opiates Co-administration of sedatives Magnesium administration
Patient factors	Advanced age Female OSA COPD Obesity Diabetes mellitus Cardiac disease Neurological disease Renal disease Opioid dependence

Up to 50% of cases of respiratory depression are spurious with no predisposing factors.



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Treatment: low dose naloxone infusion for up to 12 hours

General fluid management

Fluid management

- GMS IVI at 1.2mls/kg/hr
- Rehydration 1 litre IVI over 24 hours
- Voluven ,volulyte or balsol boluses 200 mls prn to maintain urine at 0.3 to 0.5mls/kg/hr or MAP > 60mmHg
(i.e. in response to any indicator of increasing fluid requirements)

Note

Major resection – as for TEA

Minor resection – maintain normovolaemia. Volume boluses feature less.

Notes on Guideline 3

Hepaticopancreoduodenectomy guidelines

- These procedures can be done with TEA or TEA alternative depending on facilities available.
- Central venous line insertion is not routine but may be required for access and inotropic support. This is particularly relevant if the biliary tree has been instrumented because of the perioperative risk of SIRS and sepsis.

Fluid management-maintain normovolaemia.

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Section C

TEA - thoracic epidural analgesia – How to make it work.

Aim:

- To give an appropriate anaesthetic to a well-informed co-operative patient
- To establish the block prior to incision and maintain the level at two dermatomes above incision (T4) throughout surgery continuing seamlessly into the post-op period.
- To utilize the optimal post-op infusion of 0.1% bupivacaine plus opiate for maximal pain relief and neural deafferentation with minimal side-effects
- To avoid intravenous opiates. The only place for this is when terminating the epidural and changing over to iv morphine infusion or PCA.
- Fully inform patients of the risks of epidurals without causing undue anxiety. Explain protocols are in place to detect and manage untoward events.

Position : 9/10 of success

Anxiolysis with Midazolam-titrate to effect for a co-operative patient.

Level T7-T12 :Level T9 -10 ideal for upper abdominal surgery with advantage of horizontal needle insertion up to this level. (Higher insertion can lead to urinary catheter discomfort without much benefit gained.)

Full sterile precautions-mask/gloves/cap plus gown

Chlorhexidine plus alcohol – leave to dry

Local lignocaine –infiltrate

LOR with saline

Multi-orifice catheter to 5-7 cm into space. Do not feed further than necessary as this increases the risk of inadvertent vessel infiltration. (bloody tap)

Lignocaine test dose (2 mls 2%)

Establish block prior to incision. (Pre-emptive extensive blockade reduces release of cortisol and adrenalin and reduces release of pro-inflammatory cytokines)

Establish block rapidly with bupivacaine / lignocaine mix. (7mls bupivacaine (0.5%) 3mls lignocaine)

Sensory level can be detected within 3-4 minutes. Establish volume required to attain desired sensory level. (T4)

80% of variability in peak height block and regression of block is due to CSF volume which does not correlate with other anthropomorphic measurements .i.e. we must establish volume required to attain desired level in each individual patient. This allows us to calculate volume required for hourly bolus or infusion.

-12-20 mls for T4 block. (Σ block approx.2 -6 dermatomes above sensory level)

-Paint the fence with half the total volume at half an hour.(0.25% or 0.5% Marcaine) to increase density of block. (if time allows or any CVS instability , you can omit this step and give your first hourly volume at 1 hour post TEA insertion, prior to skin incision)

-Two thirds to three quarters of original volume hourly – bolus vs infusion.(0.25% intra-op / 0.1%postop) If infusion, start immediately after first bolus at 1 hour.

-do not stop boluses and infusion intraoperatively, rather support blood pressure with appropriate fluid management, ephedrine or low dose phenylephrine (within reason).

-remember to give local anaesthetic around drains sited at the end of the procedure.

Postoperatively

-continue infusion at intraoperative rate with 0.1% bupivacaine plus opiate of choice (see below). The patient should have desired level if above adhered to.

-check hourly level for first 2-3 hours to insure infusion steady state. (it is easier to adjust the rate early to optimize level than to top up because an unmonitored epidural results in a drop in level and pain)

-top ups of 0.25% -0.5% of Marcaine can be used to increase the density of the block OR to raise the level.

Notes

3-5 ml boluses given 5 minutely up to the **total original dose** may be required to increase the density of the block.

One may need to give more than the original dose to raise the level.

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Waiting too long in between boluses will result in increasing the density of the block without raising the level.

Blood pressure instability is unlikely (unless fluid deficit) because of vasopressin release after 3-4 hrs of a well-established extensive epidural (this does not apply to high thoracic epidurals for thoracic surgery). If BP drops support with IVI fluid bolus and temporize with ephedrine.

Local anaesthetics

Only LAs have the ability to block afferent and efferent signals to and from the spinal cord suppressing the surgical stress response. They facilitate return of gastric motility, diminish inflammation and decrease blood viscosity possibly through systemic absorption.

They may be used as sole agents for sleep apnoea/COAD/opiate assoc. nausea/pruritis/resp depression. HOWEVER as sole agents the hourly rate must consistently be increased as the sensory block regresses (bolus < infusion). Rates up to 25 mls /hr of 0.1% bupivacaine are acceptable (25 mg/hr)

Total bupivacaine dose not > 2mg/kg per 4 hours.

Bupivacaine, levobupivacaine and ropivacaine are widely used. Little difference in quality of block. The potential advantages of levo and ropivacaine (less cardiotoxicity and less motor block) are not clinically relevant with the low dose of bupivacaine currently used for postoperative infusions

Opiates

Opiates act pre and post synaptically at the dorsal horn

They reduce the concentration of LA required to maintain an effective block probably by acting synergistically with the local anaesthetic. S/E such as nausea, pruritis and respiratory depression are linked to type and dose of epidural opiate used.

Lower concentrations should be used with thoracic epidurals vs lumbar epidurals

Opiates via any other route should be avoided (respiratory depression is related to total dose, use of opiate via alternative routes, concurrent sedation and age over 70.)

Morphine causes delayed respiratory depression but is the closest thing we have to an ideal epidural opiate if used at low enough doses

Pharmacological differences lie in the fact that opioids differ in their ability to reach the opioid receptor.

Epidurally administered opiates must cross the dura and arachnoid mater diffuse through CSF and traverse the pia mater to reach the surface of the spinal cord. They must then diffuse through white matter to grey matter to reach the dorsal horn.

Morphine/ hydromorphone-Hydrophilic .	Fentanyl/ Sufenta-Lipophilic
Slower onset (30-60 mins)	?Rapid onset(5-10 mins)
Increase in s/e with cephalad spread	Less s/e
Extensive CSF spread	?Most effective with catheter
Long duration of action (6-24 hr)	Shorter duration of action (2-4hr)

Controlled studies show a systemic rather than a spinal effect of epidural fentanyl. The physico-chemical properties of lipophilic drugs dictates that most of the drug does not reach its site of action at the dorsal horn.

Drugs in the epidural space can

- **Exit at intervertebral foramina /diffuse into fat and ligaments OR CROSS SPINAL MENINGES.**
- The dura is highly vascular so that the majority of lipophilic agent that does cross the dura is cleared before reaching the dorsal horn.
- BIOAVAILABILITY OF LIPID SOLUBLE AGENTS AT THE SPINAL CORD IS LOW.



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What Opiate?

1. Morphine 0.05mg/ml in postop infusion = 10 mg in 200 mls of 0.1% Marcaine = 50ug/ml morphine and 1mg/ml bupivacaine.

Start this infusion intra-op or immediately post-op. No bolus **unless** required to make the epidural work. (I.e. pain still significant in spite of adequate level and depth of local anaesthetic blockade.)

Advantages to morphine infusion only technique vs morphine bolus.

- results in doses of 300-750 ug/hr (6-15 mls /hr infusion) Apparently 200-300 ug /hr should pose no higher threat than lipophilic agents for delayed respiratory depression.

- Morphine accumulated in the CSF over two to three days via infusion has the added advantage of a up to 24 hrs further analgesia on transfer to the ward ,allowing for an easier transition to oral analgesics.

- Reducing morphine dosage should reduce S/E as they are related to total dose. Avoiding a bolus with a low dose infusion gives a longer S/E free interval.

- Respiratory depression can occur up to 24 hrs post bolus-therefore monitoring required. If no bolus has been given then the infusion can be stopped and patient discharged immediately from high care.

- Theoretical advantage over morphine bolus of maintaining bowel motility benefit of LA .

2. Fentanyl can be added instead to bupivacaine. We use 2ug/ml fentanyl with 1mg/ml bupivacaine (0.1%)