GUIDELINES FOR RATIONAL USE OF ANALGESICS, SEDATIVES, AND NEUROMUSCULAR BLOCKERS IN INTENSIVE CARE

5TH EDITION

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In addition, these guidelines could not have been produced without the excellent secretarial assistance of Annemarie Purcell.

As always, we look forward to working with the entire SUNY staff to implement these guidelines for the benefit of our patients.

INTRODUCTION

These guidelines are designed to help house staff select the proper agents and follow appropriate procedures for optimal patient analgesia*, sedation**, and neuromuscular blockade*** use within the Intensive Care Units. Our goal for use of analgesics, sedatives, and neuromuscular blockers in critical care include enhanced patient safety and comfort through control of pain, reduction of anxiety, and reduced dangerous voluntary motor activity.

These guidelines should be followed by the house staff unless specifically directed otherwise by the critical care attending. All drugs are listed in order of preferred use. Priorities for drug selection are based upon metabolic pathway hemodynamic and cardiorespiratory side effects, and cost (purchase cost with usual dose). Drugs with no demonstrated clinical advantages are ranked in order of estimated cost (low to high). Please note that the use of steroid-based neuromuscular blockers in patients on high dose steroids is controversial.

If you have any problems, questions or suggestions for improvement of this document, please contact us. Send correspondence to:

Michael F. Mascia, M.D., MPH, c/o Anesthesiology Department, 1430 Tulane Ave., Box SL4, New Orleans, LA 70112 or call 504-588-5903. We look forward to working with you on the implementation and improvement of this information.

DEFINITIONS:

*** Analgesia** - A condition in which painful stimuli are perceived, but are not interpreted as pain.

Anxiety - Apprehension of danger and dread accompanied by restlessness, tension, tachycardia, and dyspneu unattached to a clearly identifiable stimulus.

Anxiolytic - Antianxiety agent

****Sedation-** The act of calming, especially by the administration of a sedative

Sedative - A drug that quiets nervous excitement; designated according to the organ or system upon which specific action is exerted; e.g. cardiac, cerebral, nervous, respiratory, spinal

*** **Neuromuscular Blockade** (myoneural blockade) - inhibition of nerve impulse transmission at myoneural junctions by a drug such as curare

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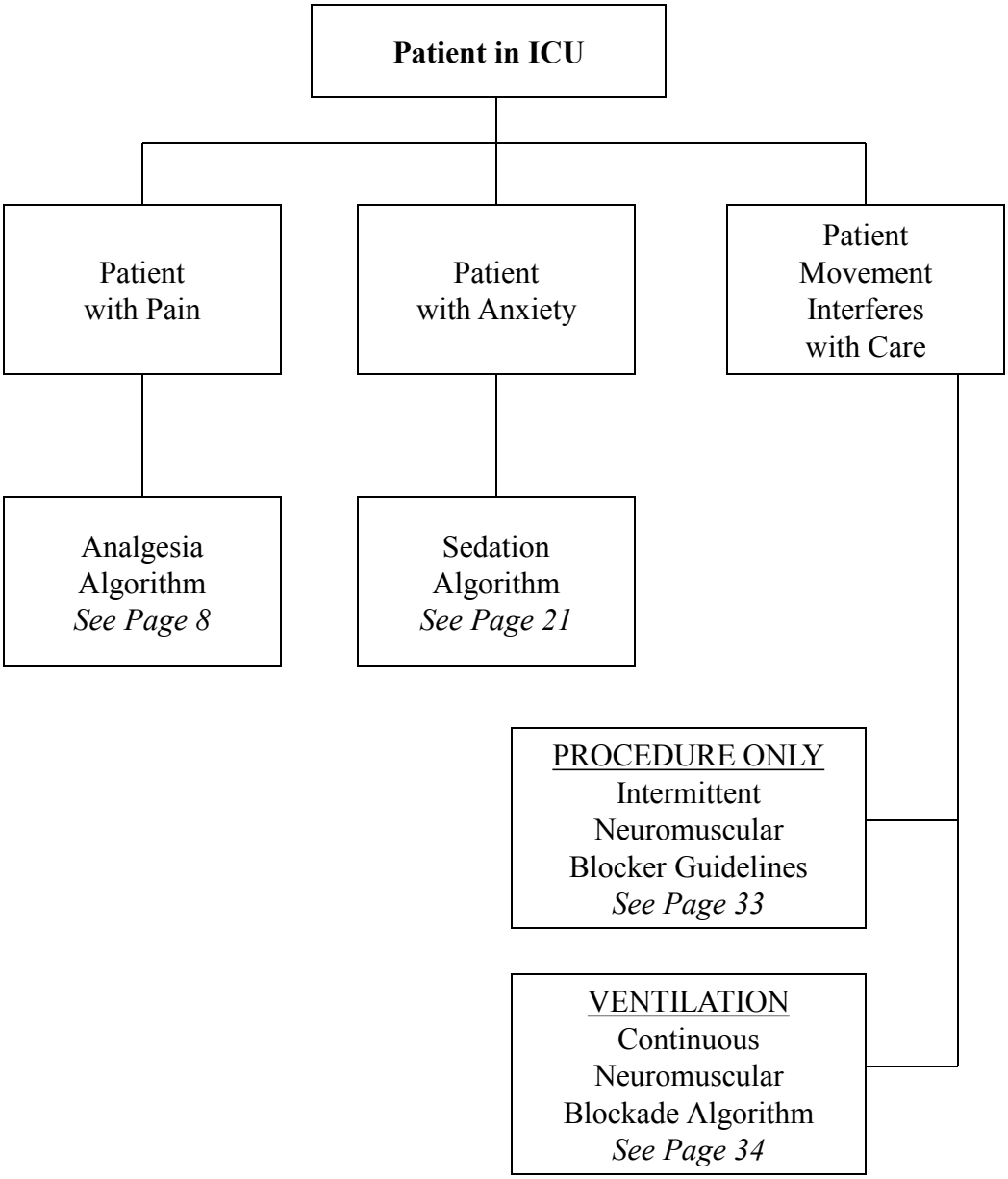
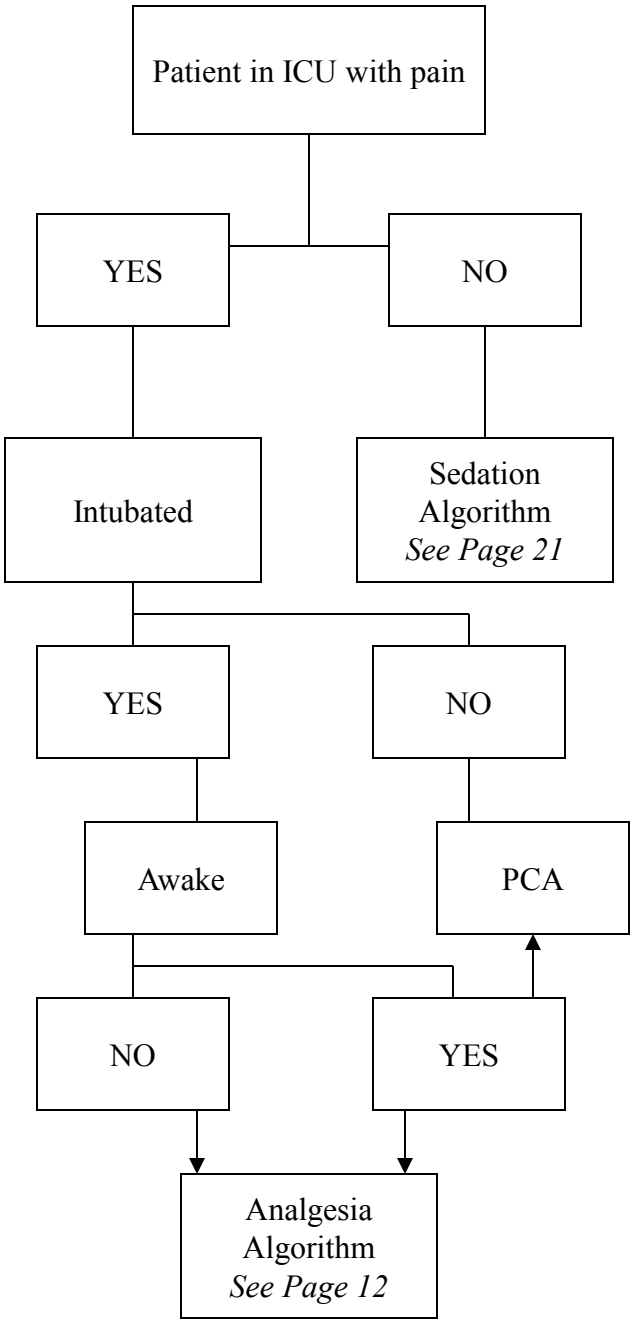
OVERVIEW

OVERVIEW:
PATIENT IN ICU



OVERVIEW:
PATIENT IN ICU WITH PAIN



OVERVIEW:
INDICATONS CHECKLIST FOR ALL PATIENTS

Analgesia/Sedation/Neuromuscular Blockade

Checklist/Agent Request Form

Directions for use: 1) fill out form 2) write orders 3) FAX or send both to Pharmacy

Step 1: INDICATION FOR MEDICATION

Analgesia	**Sedation**	**Neuromuscular Blockade**
☐ INTUBATION /Mechanical Ventilatio	☐ AGITATION	☐ PROLONGED MECHANICAL VENTILATION
☐ PAIN FROM TRAUMA	☐ DELIRIUM	unable to manage with sedation only (see pg
☐ PAIN FROM PROCEDURE (after O.	☐ ALCOHOL WITHDRAWAL	☐☐ PROCEDURE ONLY (see pg 33)
☐ PAIN ANTICIPATED FOR SCHEULE	☐ INTUBATION/VENTILATION	
PROCEDURE		

Step II: REQUIREMENTS PRIOR TO INITATING DRUG THERAPY

Part A for Analgesia

History

☐ Allergies

☐ Drug use

Current Drugs and Indications for Sedation Analgesia Neuromuscular Blockade

Desired Effect	**Drug**	**Infusion Rate**		**Indications**
☐ Analgesia	_____	_____mg/hr	☐Ventilation ☐ Anxiety	☐
☐ Sedation	_____	_____mg/hr	☐Ventilation ☐ Anxiety	☐
☐ Neuromuscular Blockade	_____	_____mg/hr	☐Ventilation ☐ Anxiety	☐

☐ Contraindications

☐ Precautions

Physical Examination

☐ Contraindications

☐ Precautions

☐ Evidence of ☐Hepatic and/or ☐Renal or ☐Hepatocelluar Dysfunction

Labs

☐ Contraindications

☐ Drug Dose Adjusted

☐ Precautions

☐ Assessment of Hepatic/Renal Function:

☐ Serum Creatinine ☐ ☐ Bilirubin Lev☐ ☐ Amonia L☐vel ☐ Hepatocellular Enzyme Level

ADD Part B for Sedation

☐ Analgesic Infusion (as per Analgesia Algorithm) Drug _____

REQUIRED BEFORE STARTING SEDATION Date _____

ADD Part C for Neuromuscular Blockade

☐ 1. Adequate analgesia (see analgesia algorithm)

☐ 2. Adequate sedation (see sedation algorithm)

☐ 3. GI prophylaxis considered	☐☐ Method (specify)	☐ H2 Blocker	☐ ☐Carafate
☐ 4. DVT prophylaxis considered	☐Method (specify)	☐ Heparin ☐Coumadin	☐ Stockings
☐ 5. Corneal abrasion prophylaxis cor	☐ Method (specify)	☐ Lube ☐Tape	
☐ 6. Assessment of Hepatic/Renal Fu	☐Other		

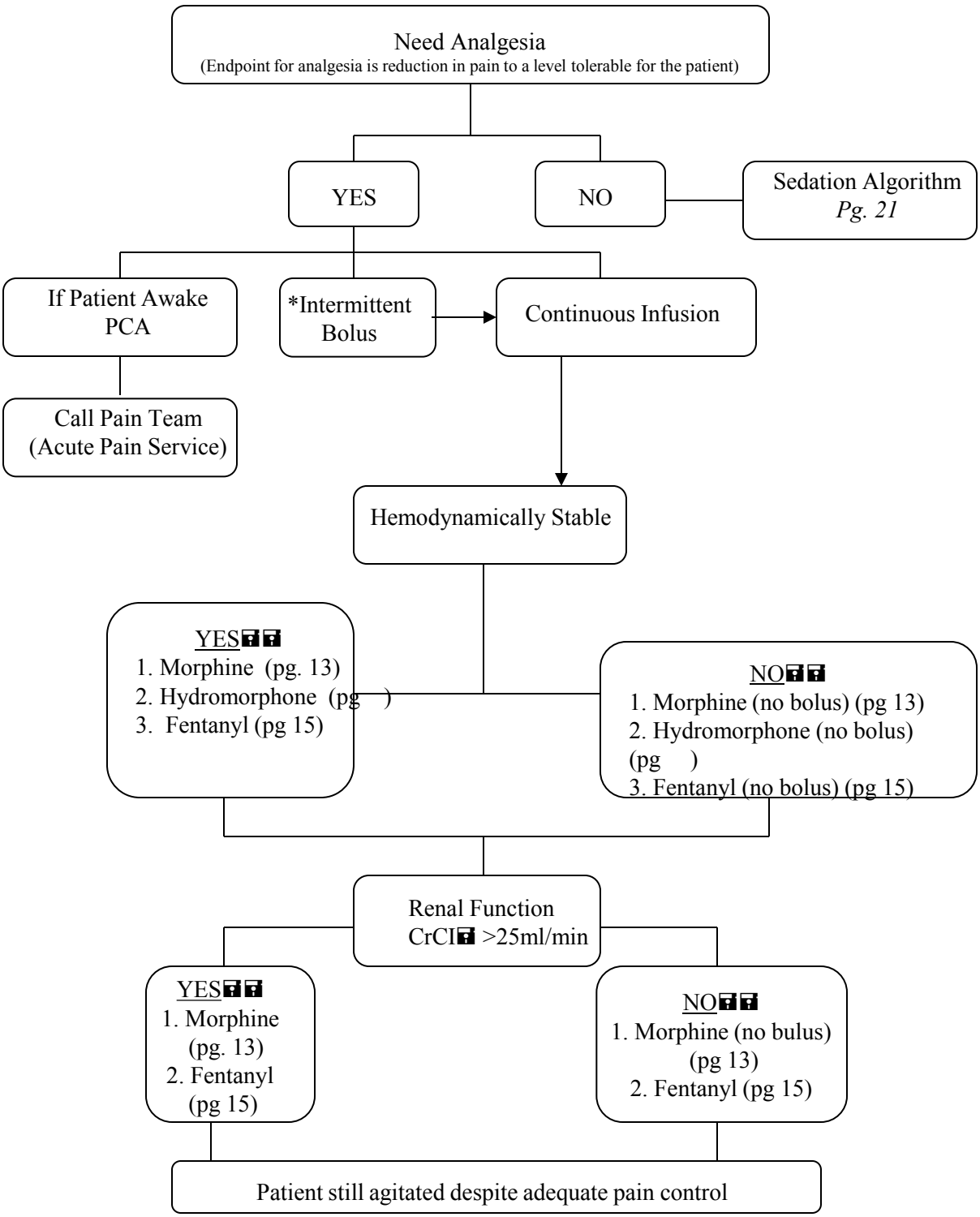
☐ Serum Creatinine ☐ Bilirubin Level ☐ Amonia Leve☐ Hepatocellular Enzyme Level

Step III: Drug Requested **Patient Weight** _____ **Patient Height** _____

Desired Effect	**Drug**	**Infusion Rate**	**Indications**
☐ Analgesia	_____	_____mg/hr	☐Ventilation ☐ Anxiety ☐Pain ☐ Other

ANALGESIA

ANALGESIA
ANALGESIA ALGORITHM



Drugs are listed in order of preference, according to cost and pharmacodynamic considerations

• Should be converted to continuous infusion ASAP

** Note: Mepridine may case CNS stimulation

Creatinine Clearance3 (estimated)

Substitute Methadone for gut dysfunction or narcotic dependency

ANALGESIA:
MORPHINE GUIDELINES

INDICATIONS:

For use as an analgesic

CONSIDERATIONS:

- Metabolic Fate
- Morphine, and all narcotics, may constrict the ampulla of Vater, preventing drainage of the pancreatic system
- Morphine can reduce systemic vascular resistance via histamine release
- Morphine glucuronide active metabolite accumulates in renal failure

DOSAGE:

Loading Dose (LD*)

- For hemodynamically stable patients, bolus of 0.15mg/kg IV every 10 minutes to a maximum of 0.2mg/kg, or until pain control is achieved
- Infuse at a total bolus dose determined above for pain control per hour
- Infusion starts at LD/hour

DOSAGE ADJUSTMENT:

- If patient is awake and alert, institute PCA or contact pain service for PCA
- If patient is not able to communicate, adjust based on HR and BP
- If patient is able to use pain analog scale, adjust accordingly

**LD (loading dose) is total dose that results in adequate analgesia by intermittent bolus, as above.*

ANALGESIA:
HYDROMORPHONE (Dilaudid®) GUIDELINES

INDICATIONS:
For use as an analgesic; alternative to morphine sulfate.

CONSIDERATIONS:
•Metabolic Fate; liver metabolism →glucuronide →excretion
Half life equals approximately 160 minutes
• Low dose
•Otherwise, same as morphine

DOSAGE:
Loading Dose (*LD)-
•Start at 10μg (micrograms) per kg bolus
•Repeat every 5 minutes to max of 40 μg (micrograms)
•Infusion starts at LD/hour

DOSAGE ADJUSTMENT:
•If patient is awake and alert, institute PCA or contact pain service for PCA
•If patient is not able to communicate, adjust based on HR and BP
•If patient able to use pain analog scale, adjust accordingly

(Refer to algorithm - page _____)

**LD (loading dose) is total dose that results in adequate analgesia by intermittent Bolus, as above.*

ANALGESIA:
FENTANYL (SUBLIMAZE®) GUIDELINES

INDICATIONS:
For use as an analgesic

CONSIDERATIONS:
•Metabolic Fate _____
•May have less hemodynamic effect
•Fentanyl tolerance can develop within 24 hours

DOSAGE:
Loading Dose (*LD)
•Start at 1µg/kg (microgram) every 5 minutes to max of 5µg/kg
•Infusion starts at LD/hour

DOSAGE ADJUSTMENT:
•If patient is awake and alert, institute PCA or contact pain service for PCA
•If patient is not able to communicate, adjust based on HR and BP
•If patient able to use pain analog scale, adjust accordingly

**LD (loading dose) is total dose that results in adequate analgesia by intermittent Bolus, as above.*

ANALGESIA:
METHADONE (DOLOPHINE®) GUIDELINES

INDICATIONS:

•For use as an analgesic in long term mechanically ventilated patients with gut dysfunction as a hepato-biliary duct obstruction or ileus
•May also be used in complete or eminent renal failure

CONSIDERATIONS:

•The half life of this drug is approximately 24 hours
•This drug may have less of an effect on the ampulla of Vater than morphine, but greater than meperidine

DOSAGE:

Loading Dose (*LD) is necessary-
•Start at 0.015mg/kg IV every 10 minutes until pain is relieved, to max of 0.2mg/kg
•Infusion starts at LD / hour

DOSAGE ADJUSTMENT:

•Assess analgesia every six hours thereafter-adjust carefully, remembering that a steady state concentration may not be achieved for over a week
•If patient is awake and alert, institute PCA or contact pain service for PCA
•If patient is not able to communicate, adjust based on HR and BP
•If patient able to use pain analog scale, adjust accordingly

**LD (loading dose) is total dose that results in adequate analgesia by intermittent Bolus, as above.*

ANALGESIA:
CLONIDINE ORAL/TRANSDERMAL GUIDELINES

DESCRIPTION:
Central Acting α_2 - Andregenic Agonist

Oral	**Transdermal**	**IV**
Via G-tube if gut is working	If gut not working	If gut not working
INDICATIONS: •Drug withdrawal •Augment narcotic analgesia •Treatment of hypertension	INDICATIONS: •Drug withdrawal •Non-functioning gut, or N.P.O. •Augment narcotic analgesia •Treatment of hypertension	INDICATIONS: •Drug withdrawal •Non-functioning gut, or N.P.O. •Augment narcotic analgesia •Treatment of hypertension
CONSIDERATIONS: Usually given via NG tube, OG tube, G tube, PO, or J tube if gut is working	**CONSIDERATIONS:** See Oral Apply weekly. Onset: 2-3 days. Duration: 7 days After removal, duration is 8 hours	**CONSIDERATIONS:**
DOSAGE: 0.1mg-0.3mg P.O. (g tub) 2x day Renal/Hepatic excretion Peak 1-3 hours - 1/2 I qh (mean)	**DOSAGE**: TTS 1 - equivalent to 0.1 bid TTS 2 - equivalent to 0.2 bid TTS 3 - equivalent to 0.3 bid	**DOSAGE**:
NB: Abrupt withdrawal may rarely cause blood pressure to exceed baseline levels in hypertensive patients.		

ANALGESIA & SEDATION:
DEXMEDETOMIDINE (PRECEDEX®) GUIDELINES

INDICATIONS:
For short term use as an analgesic / sedative; in conjunction with narcotic analgesics and transdermal or oral Clonadine with Propofol and Benzodiazepines for rescue.

CONSIDERATIONS:
•Metabolic Fate
•Hemodynamic Instability

DOSAGE:
Loading Dose (*LD) - not necessary for most patients, however, when necessary 0.5 to 1.0 microgram per kilogram over 10 to 30 minutes

Start infusion at 0.2 micrograms per kilogram per hour

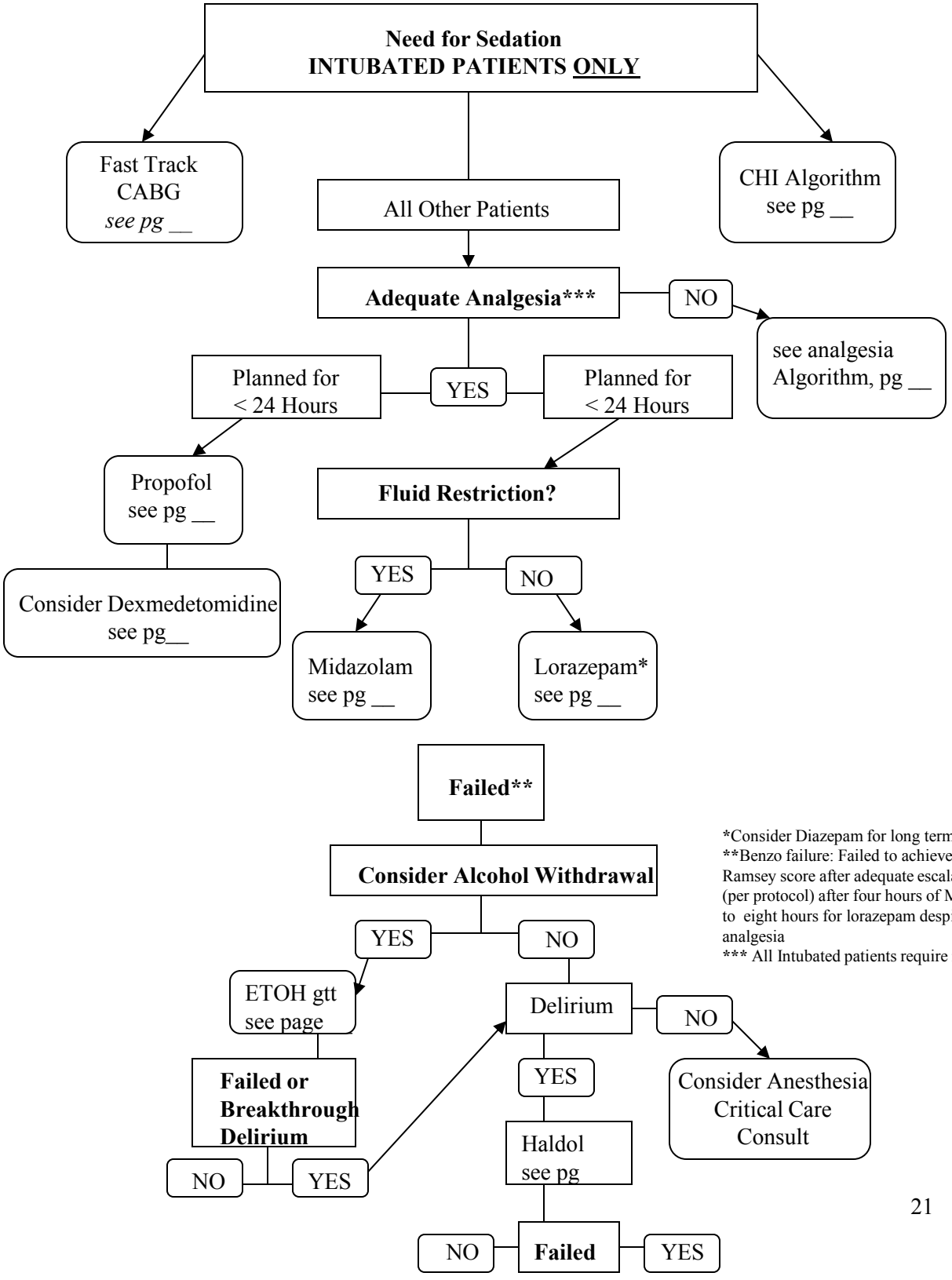
DOSAGE ADJUSTMENT:
If hemodamically stable, may titrate to a maximum of 1.0 micrograms per kilogram per hour until adequate sedation has been achieved. Infusion should be discontinued and alternative therapies initiated by 24 to 48 hours or at any time if patient becomes hypotensive during Dexmedetomidine infusion.

**LD (loading dose) is total dose that results in adequate sedation. Dexmedetomidine alone may not result in adequate analgesia or sedation. For these reasons, narcotics Propofol or benzodiazepines may be used to enhance the analgesic and sedative effects.*

SEDATION

SEDATION:
AGITATION AND DELIRIUM ALGORITHM

Endpoint for sedation is a calm, cooperative patient, despite the stress of ICU care



*Consider Diazepam for long term sedation
**Benzo failure: Failed to achieve appropriate Ramsey score after adequate escalating doses (per protocol) after four hours of Midazolam, and six to eight hours for lorazepam despite adequate analgesia
*** All Intubated patients require narcotic analgesia

SEDATION:
POST - OP CABG "FAST TRACK"

Fast Track Options (INTUBATED PATIENTS ONLY*)

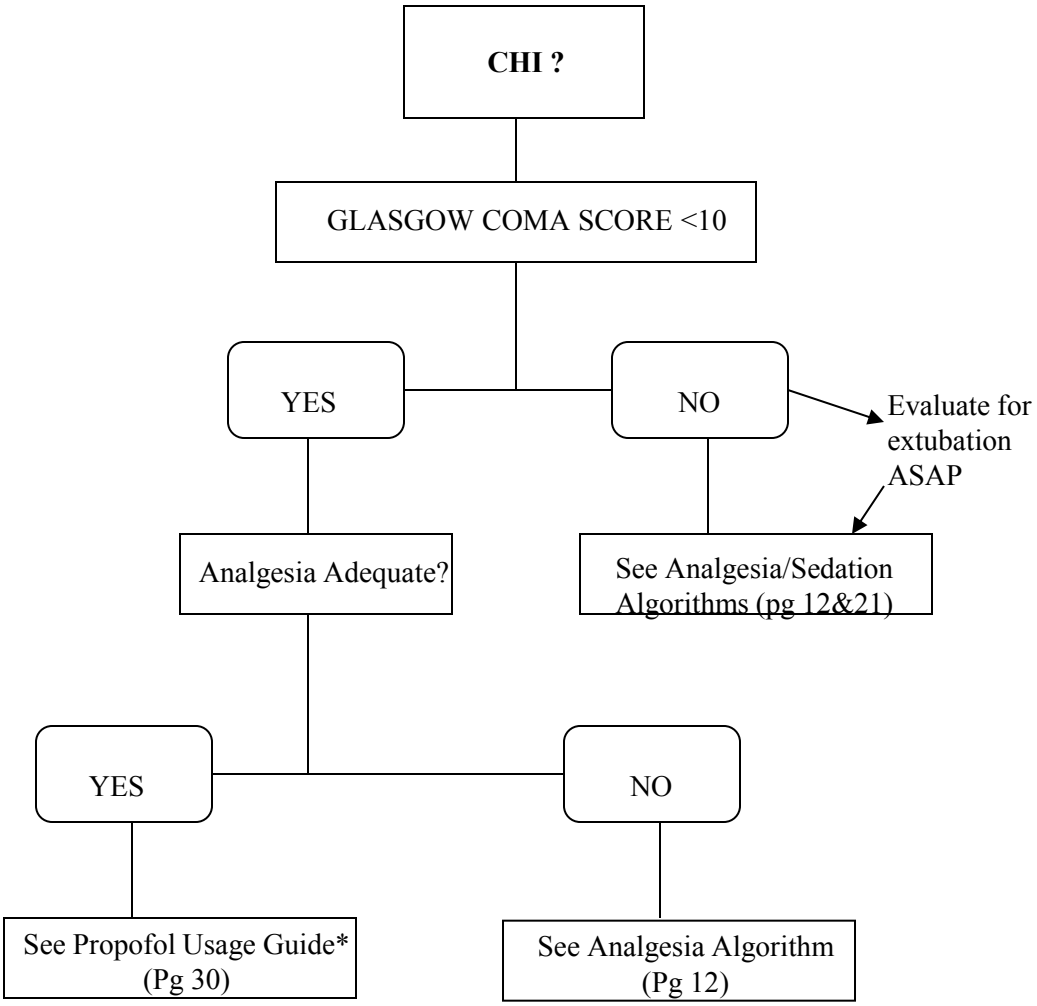
DEFINITION:
Expected short stay in ICU and extubation planned within 24 hours

ALL PATIENTS MUST HAVE:
- Normal LV function post-op (C.I. Greater than 2.5)
- Minimal inotropes (I.e., may be on renal dose dopamine)
- No mechanical hemodynamic support
- $FiO_2 < 50\%$
- PEEP 5 or less
- No neuromuscular blockade
- No ongoing myocardial ischemia
- No ongoing bleeding
- Planned extubation within 24 hours

OPTIONS for SEDATION and ANALGESIA
1. Sedation - propofol / Morphine / PCA (see pgs 13&30)
2. Propofol sedation - fentanyl (see pgs 15 & 30)
3. Propofol / alfentanil (anesthesiology only)
4. Propofol sedation / sufentanyl (anesthesiology only)

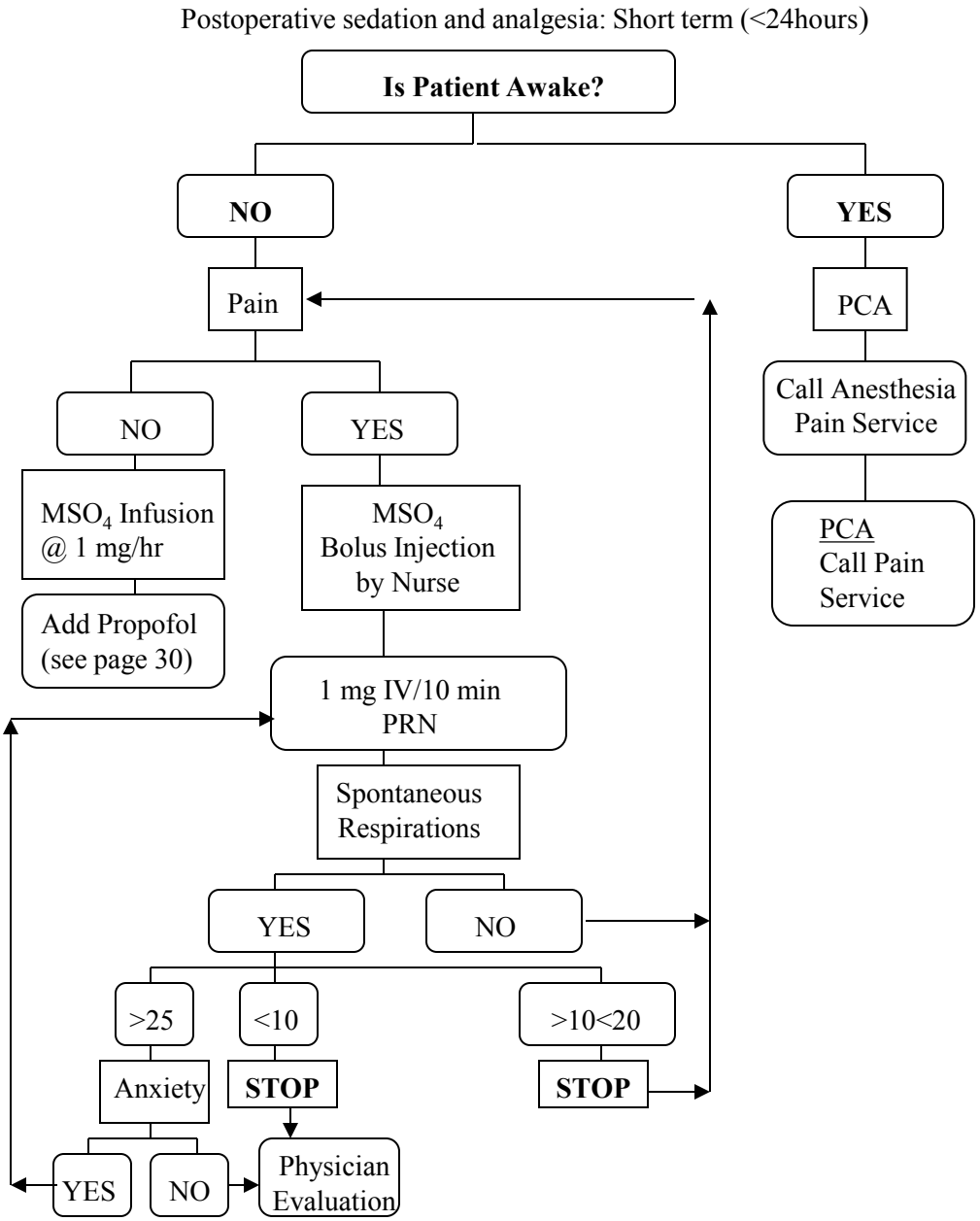
**Extubated patients are not candidates for propofol administration*

SEDATION:
LORAZEPAM (ATIVAN®) GUIDELINES



**Long term use is permitted for sedation in this population only*

SEDATION:
SHORT - TERM POST - OP SEDATION ALGORITHM*
*Intubated Patients ONLY



SEDATION:
LORAZEPAM (ATIVAN®) GUIDELINES

INDICATIONS:
For use as a long term (>24 hours) sedative in the agitated, mechanically ventilated, non fluid restricted adult

CONSTRAINDICATIONS:
Allergy to Lorazepam

CONSIDERATIONS:
•Metabolic Fate

DOSAGE:
•Give 2 mg IVP over 5 min
•Start infusion at 1mg/hr

DOSAGE ADJUSTMENT:
•Assess adequacy of sedation every 30 minutes
•If inadequate sedation after 30 minutes, repeat bolus of 2mg and increase by 1mg/hr until adequate sedation is achieved

ADMINISTRATION:
•Due to the drug's relatively poor stability, mix at 0.2mg/ml
•Lorazepam infusions should be administered via a port closest to the patient
•Tubing should be changed every 24 hours, use Nitro tubing and Churchill Filter (0.5 micros)

MONITORING:
Anticipate transient hypotension from vasodilatation

SEDATION:
DIAZEPAM (VALIUM®) GUIDELINES

Lorazepam = $0.55/MG + Churchill filter @ $1.50 ea (6/96)
Diazepam = $0.03/mg + PCA cartridge @ $8.84 ea (6/96)

INDICATIONS:
For use as a very long term (>72 hours) sedative in the agitated, mechanically ventilated, ICU adult

CONSTRAINDICATIONS:
History of adverse reaction to diazepam or propylene glycol

CONSIDERATIONS:
- Stay on top of this drug by monitoring Ramsey scores* and backing off as suggested below!
- Most experience exists with burn patients
- Active metabolites are desmethyldiazepam & methyloxazepam, which are converted to oxazepam then undergo conjugation with glucuronide attachment, and are excreted
- Diazepam half life in normal population is 36 hours
- Diazepam half life in burn patients is 43-72 hours
- Desmethyldiazepam active metabolite half life is 78 hours in ICU population

DOSAGE:
- Loading Dose (LD*) - Start at 70µg/kg over 5 minutes
- Infusion starts at LD / hour
- Commonly, doses of 140-280 µg/kg/hr will be needed

DOSAGE ADJUSTMENT:
- Assess adequacy of sedation every 30 minutes
- If Ramsey score >2, repeat bolus of 70µg/kg and increase infusion by 30mg/kg/hr - continue to assess, rebolus, and change rate as necessary
- Commonly, doses of 140-280µg/kg/hr will be needed
- If Ramsey score >4, (in the absence of neuromuscular blockage), turn infusion off until Ramsey is <4, and re-initiate at 25% previous rate

ADMINISTRATION:
- The drug will be administered undiluted via a PCA pump
- Pharmacy will load an empty PCA cassette at a concentration of 5mg/ml
- Utilize continuous infusion mode of PCA pump
- Use a dedicated central line - not peripheral

SEDATION:
MIDAZOLAM (VERSED®) GUIDELINES

INDICATIONS:
For use as a long term (>24 hours) sedative in the agitated, mechanically ventilated, **fluid restricted** adult.

CONSTRAINDICATIONS:
•Allergy to benzodiazepines

CONSIDERATIONS:
•Metabolic Fate

DOSAGE:
•Loading Dose (LD*) -
•Start at 3mg over 3 minutes
•Infusion starts at 2mg/hr

DOSAGE ADJUSTMENT:
•Assess adequacy of sedation every 15 minutes
•If inadequate sedation after 30 minutes, repeat bolus of 3mg and increase by 2mg/hr until adequate sedation is achieved

ADMINISTRATION:
•The standard concentration is 50mg/100ml
•Midazolam infusions can be infused in the same line as atracurium, vecuronium, pancuronium, and morphine

MONITORING:
Anticipate transient hypotension from vasodilatation

SEDATION:
HALOPERIDOL (HALDOL®) GUIDELINES

For Continuous infusion of halperidol study, contact Drs. Marx, Mascia, or Medicis

INDICATIONS:
For agitated patients with delirium and/or who have failed to respond to Benzodiazepine infusions per protocol

CONSTRAINDICATIONS:
•Allergy to halperidol
•Patients with a history of Torsades-de-Pointes, Parkinson's
•Patients receiving other agents which can prolong QT intervals, including quinidine, procainamide, disopyramide, amidarone, sotolol, and cisapride
•Patients with prolonged baseline QT with interval period

CONSIDERATIONS:
•Metabolic Fate

DOSAGE:
•Loading Dose (LD*) - Start at 1mg IV over 5 minutes to a max of 10 mg
•Infusion starts at LD / hr

DOSAGE ADJUSTMENT:
•Assess adequacy of sedation every 60 minutes
•If agitation persists, repeat LD, and increase by LD / hr
•Continue to assess adequacy of sedation every hour, and increase infusion up to 25 mg/hr or stop if prolongation of QT interval occurs

ADMINISTRATION:
•The standard concentration is 250mg/250ml D_5W or NS

MONITORING:
Monitoring for dysrhythmias, including prolongation of QTc interval
•If >25% increase in QTc interval above baseline occurs, decrease dose or discontinue infusion

SEDATION:
ETHANOL GUIDELINES

INDICATIONS:
For agitated patients with delirium and/or hemodynamic effects secondary to alcohol withdrawal

CONSIDERATIONS:
•Metabolic Fate

DOSAGE:
•Loading Dose (LD*) - Start at 0.1g/kg IV over 10 minutes
•Infusion starts at LD / hr

DOSAGE ADJUSTMENT:
•Assess adequacy of sedation after 30 minutes
•Monitor serum level 2 hours after starting infusion
•If agitation persists, and level is not detectable, increase infusion by 0.05g/kg/hr, and repeat serum level in 2 hours. If agitation still persists, and level is detectable but <50mg/dl, add haldol®
•If level is >50mg/dl, decrease infusion by 0.05g/kg/h, and repeat level in 2 hours. If still agitated, and level not detectable, repeat as indicated previously

ADMINISTRATION:
•Administer as a 10% solution IV D_5W. Use max volume of 100cc/h, then go to higher concentration
•10% solution = 10g Ethanol/100ml solution
•Can be given IV or PO
•PO: Proof/2 = percent = g/100ml

MONITORING:
Ethanol level, same as benzodiazepines

SEDATION:
PROPOFOL (DIPRIVAN®) GUIDELINES

INDICATIONS:
For use with patients on adequate opioid infusion; to enhance sedation in the agitated mechanically ventilated adult patient for short term use (<24 hours). Long term use for closed head injury only.

CONTRAINDICATIONS:
Hemodynamic instability, egg allergy, Hyperlipidemia

CONSIDERATIONS:
•Metabolic Fate

DOSAGE:
•Infusion starts at 5μg/kg/min, or, if in a continuous infusion from the OR, starting dose should be based upon anesthesiologist's dose on ICU arrival

DOSAGE ADJUSTMENT:
•Assess adequacy of sedation every 10-20 minutes. Increase or decrease infusion rate by 5-10μg/kg/min until desired sedation is achieved. Be sure to wait at least 10 min between adjustments to allow onset of maximal sedative and hemodynamic effects
•All patients should have opioid infusion prior to starting propofol. Patients not receiving other sedative or analgesic drugs may require propofol infusions of 50mg/kg/min or higher. These higher rates may increase likelihood of hypotension.
•Adjust fat in nutrition formula (propofol contains 0.1g fat/ml
•Monitor triglyceride level q 2 days
•Note that concurrent morphine will produce a synergistic effect

ADMINISTRATION:
•Propofol is an emulsion which contains no antimicrobial preservatives. Strict aseptic techniques should be followed
•The vial should be disinfected with 70% alcohol swab. The tubing and unused drug should be discarded 12 hours after spiking
•Do not administer if the phases of the emulsion separate
•An infusion pump must be utilized
•The compatibility of propofol with other drugs has NOT been established. Use a separate central line, if possible

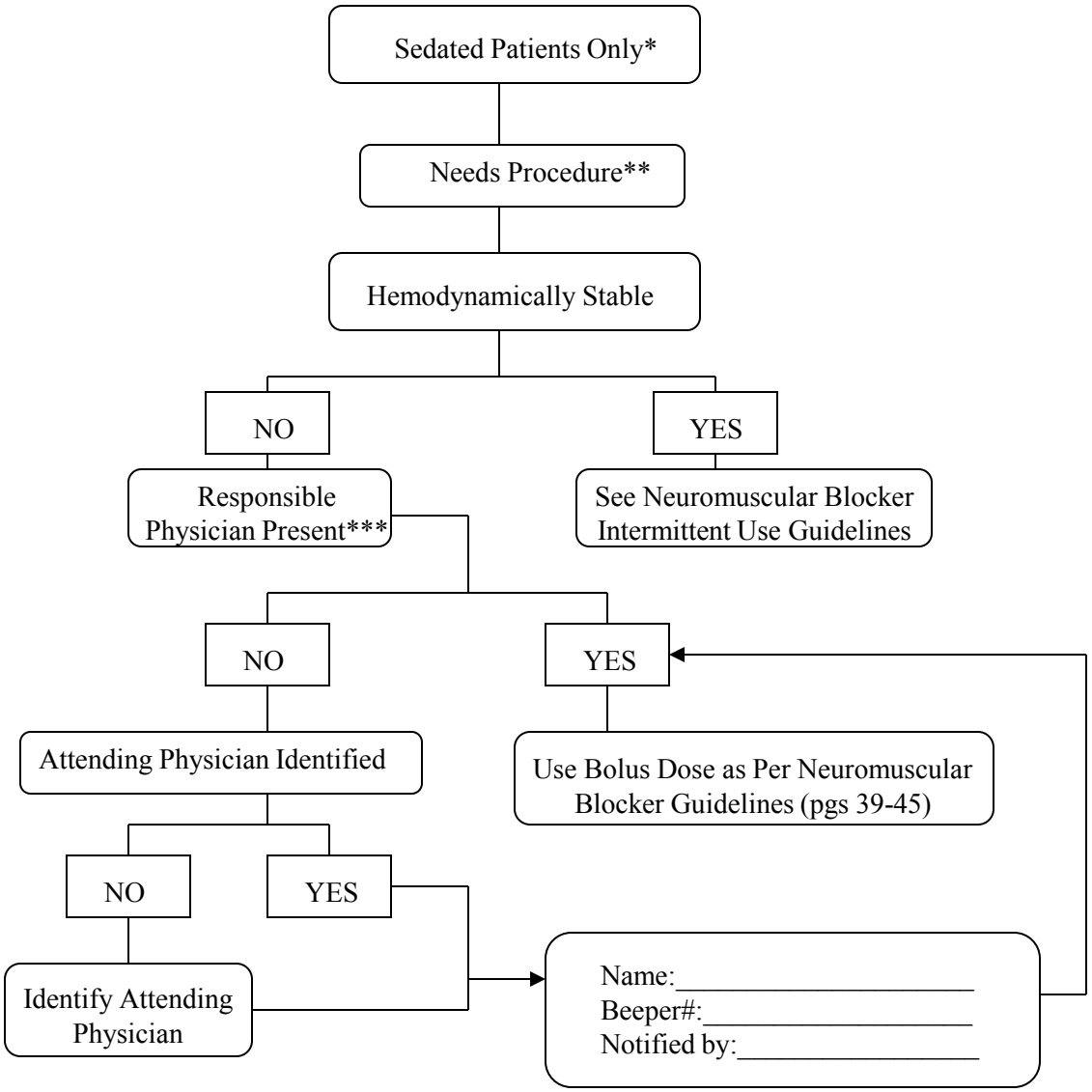
MONITORING:
•Anticipate transient hypotension from vasodilatation

NEUROMUSCULAR BLOCKERS

NEUROMUSCULAR BLOCKERS:
INTERMITTENT BOLUS ALGORITHM

Guidelines for Selection and Usage

(Outside the O.R./Intubated Patients Only)

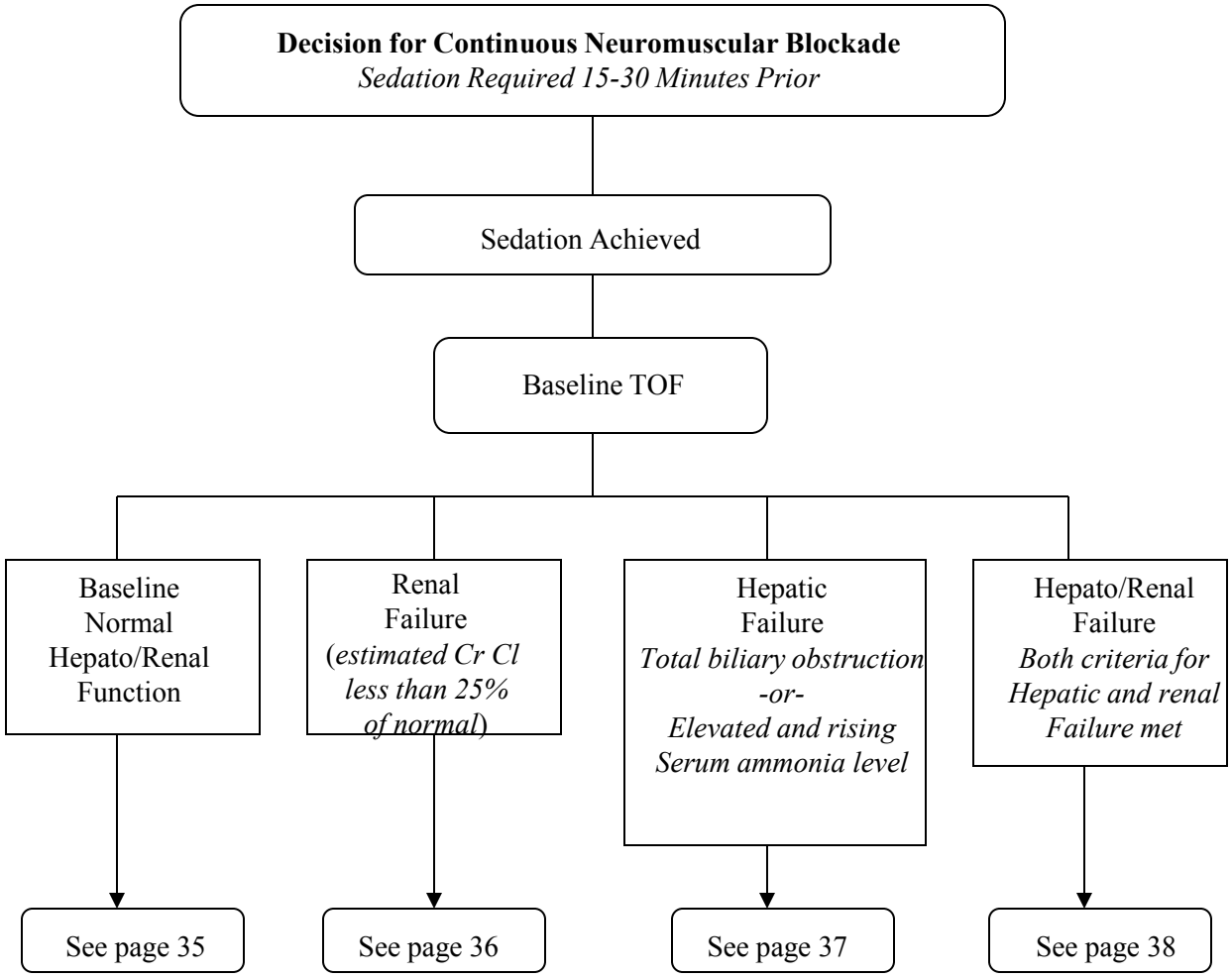


*See Sedation Guidelines, page 21

**Radiologic procedures and other procedures without hemodynamic and/or airway compromise

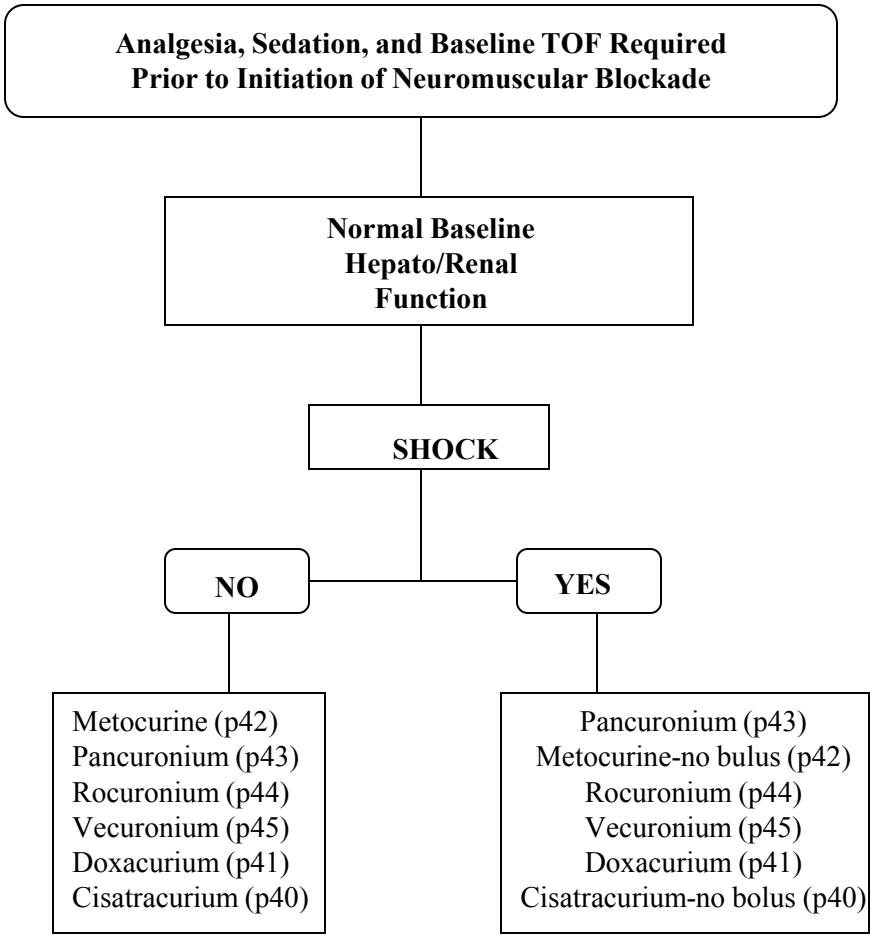
***Attending Physician or Designee

NEUROMUSCULAR BLOCKERS:
CONTINUOUS INFUSION ALGORITHM



1. Agents are listed in order of preference based on the following
   a. Metabolic pathway; b. cardiorespiratory side effects; c. purchase cost with average dose
2. Drugs that lack a definitive clinical advantage are ranked in order of estimated cost *(purchase cost with average dose)*
3. The use of steroid based drug in patients on high doses of steroids is controversial

NEUROMUSCULAR BLOCKERS:
NORMAL BASELINE HEPATO/RENAL FUNCTION ALGORITHM

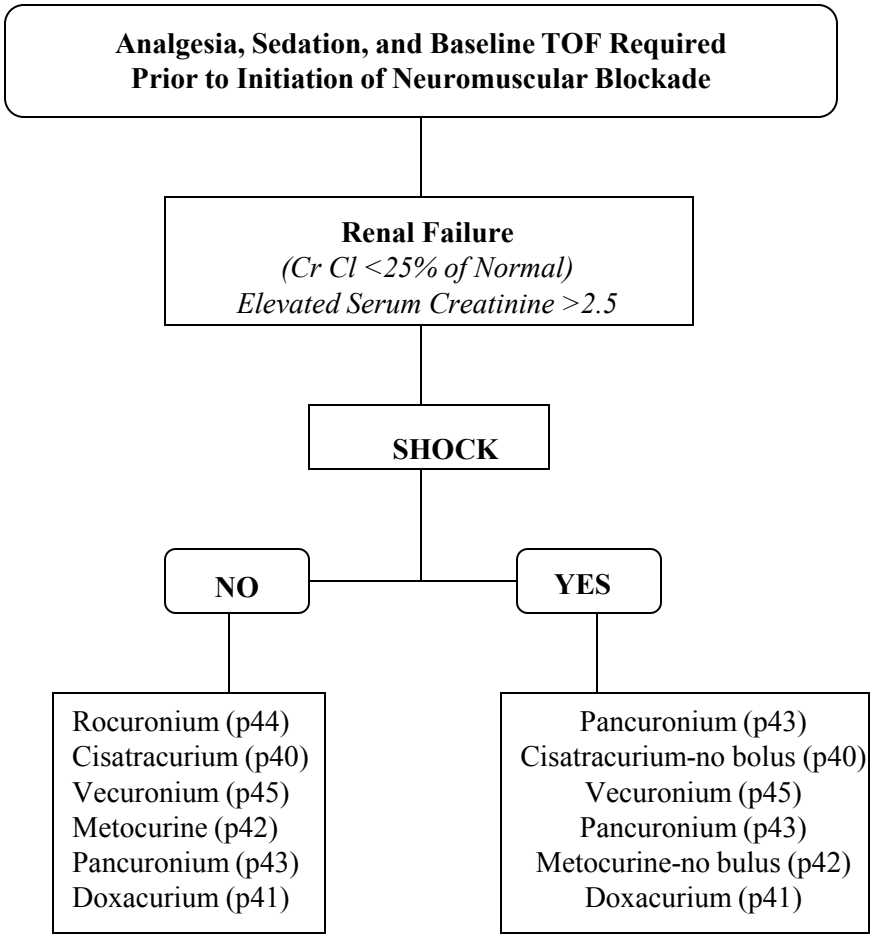


<u>Drugs are Listed in Order of Preference</u>
Priority for Drug Selection Are Based Upon:

1. **Metabolic Pathway**
2. **Hemodynamics/cardiorespiratory side effects**
3. **Cost - purchase cost with average dose**

NOTE: Drugs with no definitive clinical advantage are ranked in order of estimated cost (low to high). The use of steroid based neuromuscular blockers in patients on high dose steroids is controversial.

NEUROMUSCULAR BLOCKERS:
RENAL FAILURE ALGORITHM

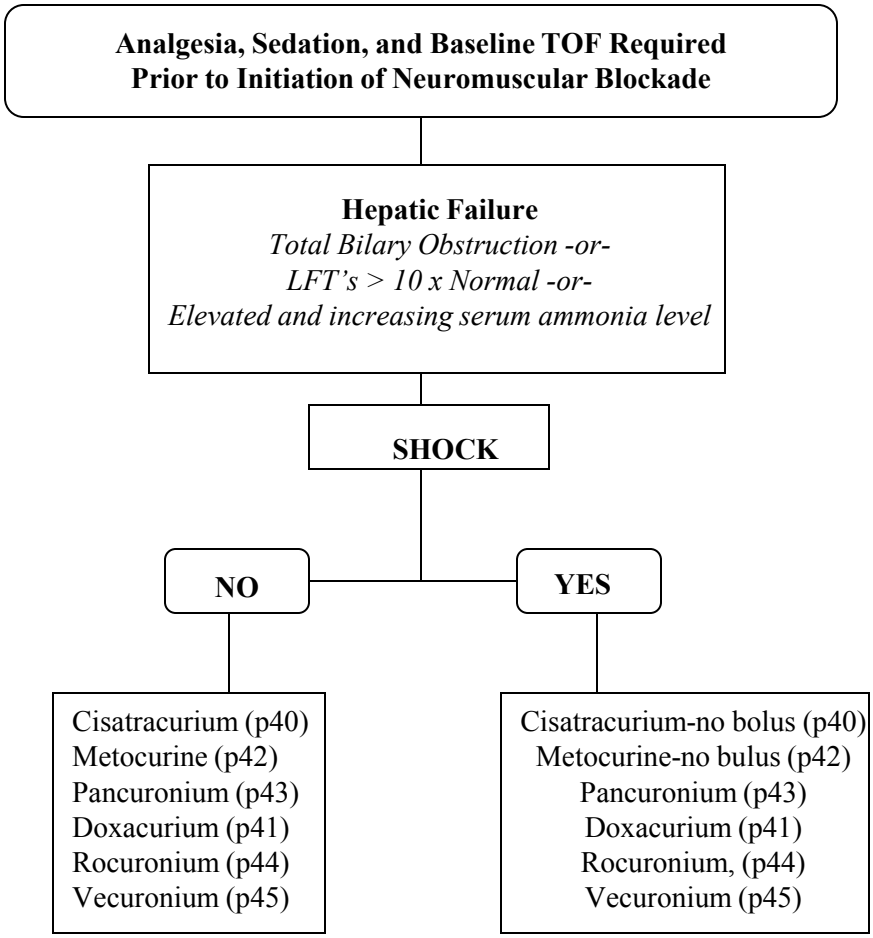


<u>Drugs are Listed in Order of Preference</u>
Priority for Drug Selection Are Based Upon:

1. **Metabolic Pathway**
2. **Hemodynamics/cardiorespiratory side effects**
3. **Cost - purchase cost with average dose**

NOTE: Drugs with no definitive clinical advantage are ranked in order of estimated cost (low to high). The use of steroid based neuromuscular blockers in patients on high dose steroids is controversial.

NEUROMUSCULAR BLOCKERS:
HEPATIC FAILURE ALGORITHM

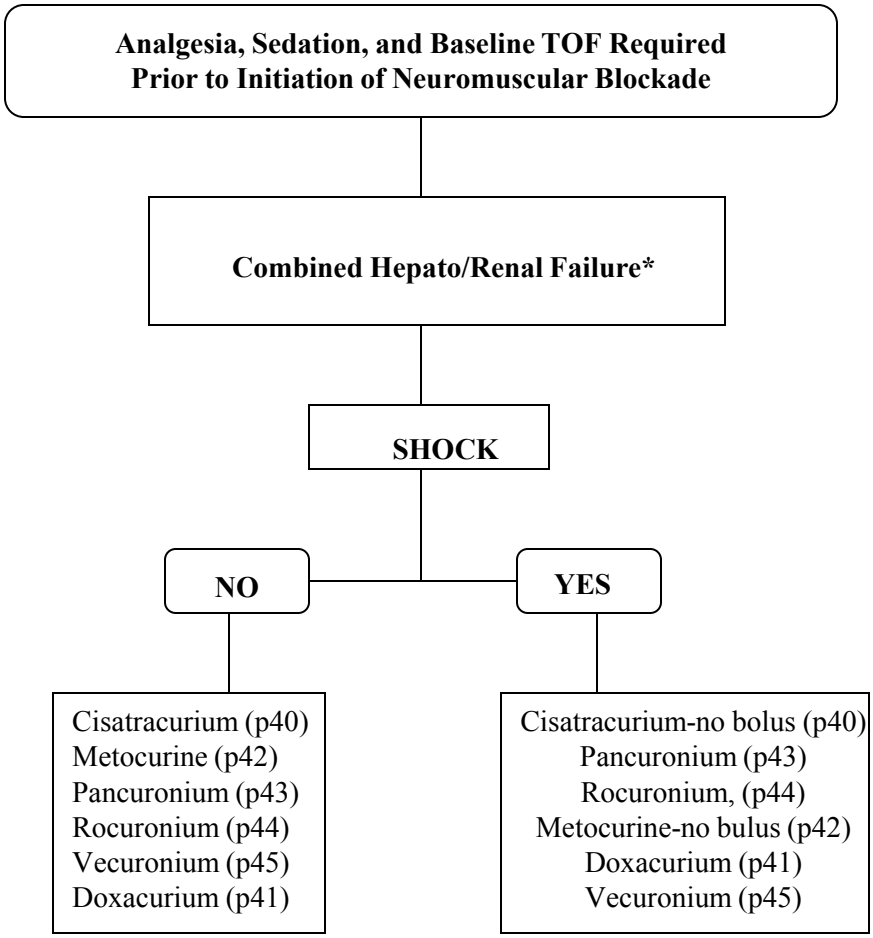


<u>Drugs are Listed in Order of Preference</u>
Priority for Drug Selection Are Based Upon:

1. **Metabolic Pathway**
2. **Hemodynamics/cardiorespiratory side effects**
3. **Cost - purchase cost with average dose**

NOTE: Drugs with no definitive clinical advantage are ranked in order of estimated cost (low to high). The use of steroid based neuromuscular blockers in patients on high dose steroids is controversial.

NEUROMUSCULAR BLOCKERS:
COMBINED HEPATO/RENAL FAILURE ALGORITHM



***ALL DRUG DOSES SHOULD BE REDUCED AND BASED UPON CLINICAL RESPONSE WITH CLOSE MONITORING OF TOF**

<u>Drugs are Listed in Order of Preference</u>
Priority for Drug Selection Are Based Upon:

1. **Metabolic Pathway**
2. **Hemodynamics/cardiorespiratory side effects**
3. **Cost - purchase cost with average dose**

NOTE: Drugs with no definitive clinical advantage are ranked in order of estimated cost (low to high). The use of steroid based neuromuscular blockers in patients on high dose steroids is controversial.

NEUROMUSCULAR BLOCKERS:
ATRACURIUM (TRACRIUM®) GUIDELINES

INDICATIONS:
For use as a neuromuscular blocker in patients with hepatic/renal failure, and/or
High steroid use*

CONSIDERATIONS:
•Metabolic Fate
•Duration=20-30 min
•Clearance: Plasma esterases
  Hoffman elimination=>Laudanosine
  Renal<5%
•Class: Benzylisoquinolinium
•Laudanosine may be neuro excitatory
•Histamine release with fast rates of bolus injection

DOSAGE:
•Bolus: 0.4-0.5μg/kg
•Infusion starts at 5μg/kg/hr

DOSAGE ADJUSTMENT:
•See NM Blocker adjustment guidelines, pg. 50

ADMINISTRATION:
•Mix 500mg in 250ml D_5W or NS
•May be given via syringe pump as necessary

**The advantages of nonsterioidal neuromuscular blockers have not been proven*

NEUROMUSCULAR BLOCKERS:
CISTRACURIUM (NIMBEX®) GUIDELINES

INDICATIONS:
For use as a neuromuscular blocker in patients with hepatic/renal failure, and/or High steroid use*

CONSIDERATIONS:
•Cisatracurium is an isomer and is very similar to atracurium. It has a little longer duration and a less toxic metabolite

ADVERSE EFFECTS:
•It is noteworthy that experience with this drug in the critical care setting is limited. Bronchospasm, bradycardia, hypotension, and rash have been reported to be associated with this agent, but due to the limited experience, none have any proven casualty.

DOSAGE:
•Establish baseline train of four (TOF)
•Bolus with 0.1mg/kg
•When TOF=2/4, start infusion at 5μg/kg/min and titrate 15 min to satisfactory ventilatory status and/or appropriate TOF (see NM Blocker adjustment guidelines, pg.50)
•Doses as high as 10.2μg/kg/min may be necessary

ADMINISTRATION:
•Cisatracurium can be mixed as long as 10mg/100ml, and up to 40mg/100ml
•The drug can be mixed D_5,NS, D_5NS, and may be y-sited with fentanyl, midazolam, or droperidol. DO NOT administer in the same line as propofol or kertorlac
•Vials should be stored in the refrigerator

**The advantages of nonsterioidal neuromuscular blockers have not been proven*

NEUROMUSCULAR BLOCKERS:
DOXACURIUM (NUROMAX®) GUIDELINES

INDICATIONS:
For use as a neuromuscular blocker to facilitate a procedure or for ventilatory management, especially in patients with combined high dose steroid use

CONSIDERATIONS:
•Metabolic Fate
•Duration: 110-338min
•Clearance: Mostly renal and biliary excretion
•Class: enzylisoquinolinium
•Very Potent

DOSAGE:
•Bolus: 0.08mg/kg over 5-15min
•Infusion: Starting 1μg/kg/min

DOSAGE ADJUSTMENT:
•See NM Blocker adjustment guidelines, pg.50

ADMINISTRATION:
•Mix 20mg in 250ml of D_5W or NS

**The advantages of nonsterioidal neuromuscular blockers have not been proven*

NEUROMUSCULAR BLOCKERS:
METOCURINE (METUBINE®) GUIDELINES

INDICATIONS:
For use as a neuromuscular blocker to facilitate a procedure or for ventilatory management

CONSIDERATIONS:
•Metabolic Fate
•Duration: 80-100min
•Clearance: Primarily eliminated by the kidneys
•Non-steroidal curare derivative

DOSAGE:
•Bolus: 0.3mg/kg over 5-15min
•Infusion: Starting 5μg/kg/min

DOSAGE ADJUSTMENT:
•See NM Blocker adjustment guidelines, pg.50

ADMINISTRATION:
•Mix 80mg in 250ml of D_5W or NS

**The advantages of nonsterioidal neuromuscular blockers have not been proven*

NEUROMUSCULAR BLOCKERS:
PANCURONIUM (PAVULON®) GUIDELINES

INDICATIONS:
For use as a neuromuscular blocker to facilitate a procedure or for long term paralysis

CONSIDERATIONS:
•Metabolic Fate
•Duration: 80-100min
•Clearance: Mostly renal elimination
•Active metabolites
•Tachycardia and hypertension are due to vagolytic and/or sympathomimetic effect (location and mechanism is not completely understood
•Class: Steroidal

DOSAGE:
•Bolus: 0.1mg/kg over 5-15min
•Infusion: Starting 0.8μg/kg/min

DOSAGE ADJUSTMENT:
•See NM Blocker adjustment guidelines, pg.50

ADMINISTRATION:
•Mix 50mg in 250ml of D_5W or NS

**The advantages of nonsterioidal neuromuscular blockers have not been proven*

NEUROMUSCULAR BLOCKERS:
ROCURONIUM (ZEMURON®) GUIDELINES

INDICATIONS:
For use as a neuromuscular blocker to facilitate a procedure or for long term ventilatory management

CONSIDERATIONS:
•Metabolic Fate
•Duration: 30-60min
•No active metabolites
•Clearance: Mostly hepatic
•Class: Steroidal

DOSAGE:
•Bolus: 0.3mg-0.6mg/kg
•Infusion: Starting 5μg/kg/min

DOSAGE ADJUSTMENT:
•See NM Blocker adjustment guidelines, pg.50

ADMINISTRATION:
•Mix 500mg in 250ml of D_5W or NS

**The advantages of nonsterioidal neuromuscular blockers have not been proven*

NEUROMUSCULAR BLOCKERS:
VECURONIUM (NORCURON®) GUIDELINES

INDICATIONS:
For use as a neuromuscular blocker to facilitate a procedure or for ventilatory management

CONSIDERATIONS:
•Metabolic Fate
•Duration: 30-60min
•Up to 40% renal
•Up to 50% bile
•Up to 60% hepatic - 3a hydrovec is active
•Active metabolites excreted renally
•Class: Steroidal

DOSAGE:
•Bolus: 0.1mg/kg over 5-15 min
•Infusion: Starting 2µg/kg/min

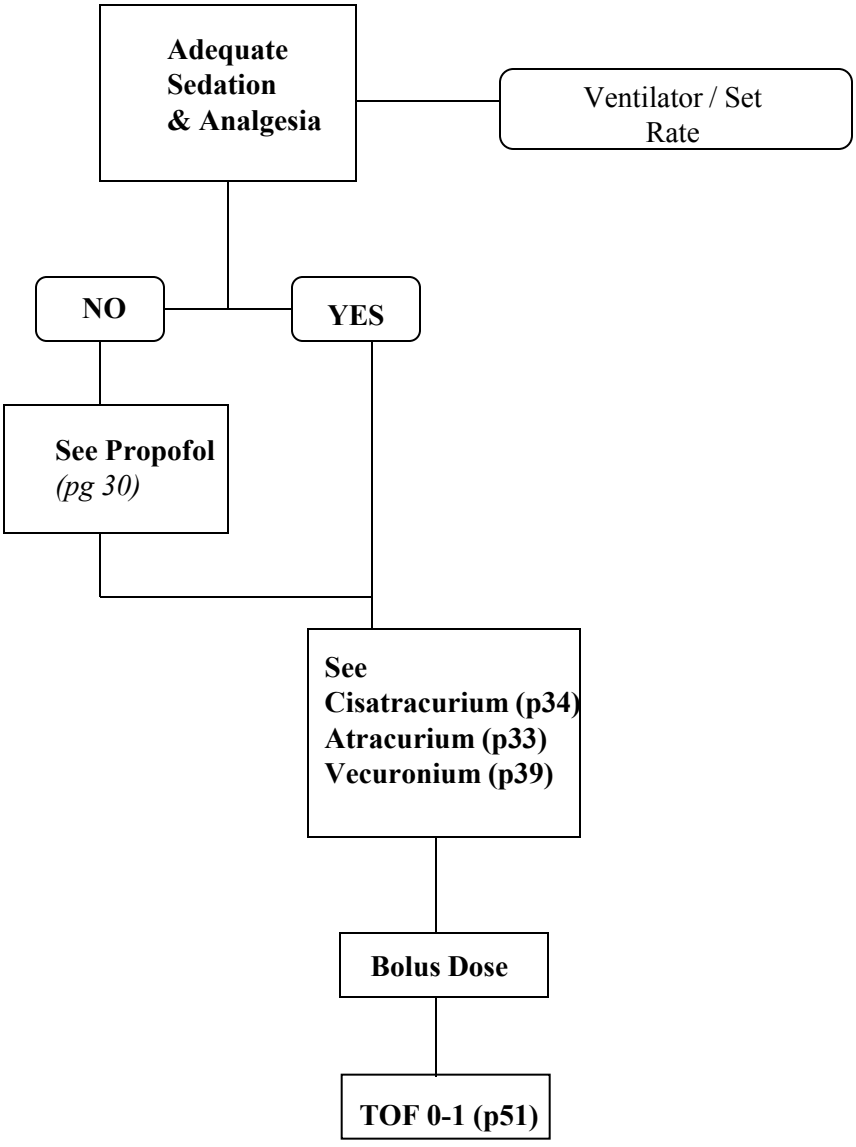
DOSAGE ADJUSTMENT:
•See NM Blocker adjustment guidelines, pg.50

ADMINISTRATION:
•Mix 100mg in 250ml of D_5W or NS
•Use multi-dose vials (less expensive)

*The advantages of nonsterioidal neuromuscular blockers have not been proven

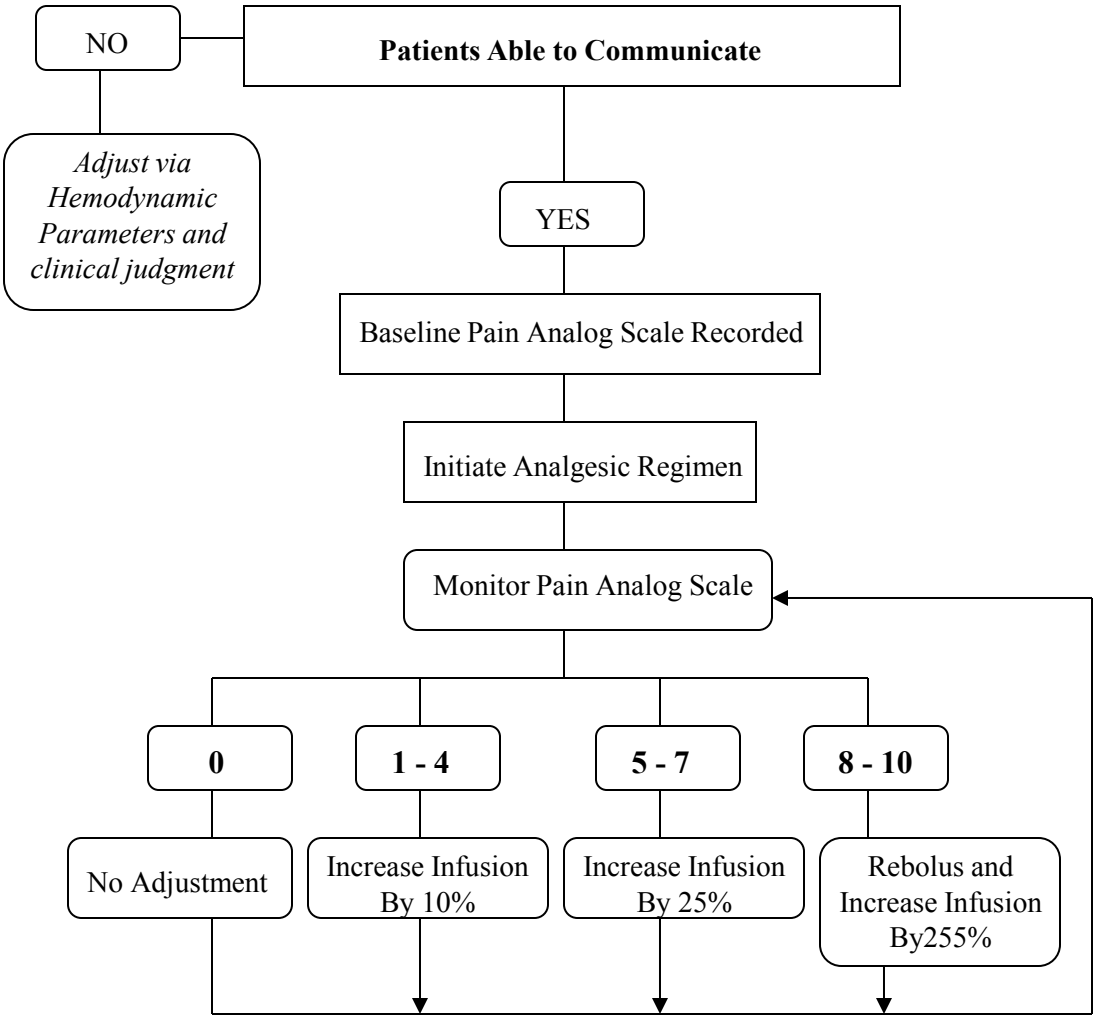
NEUROMUSCULAR BLOCKERS:
INTERMITTENT USAGE GUIDELINES

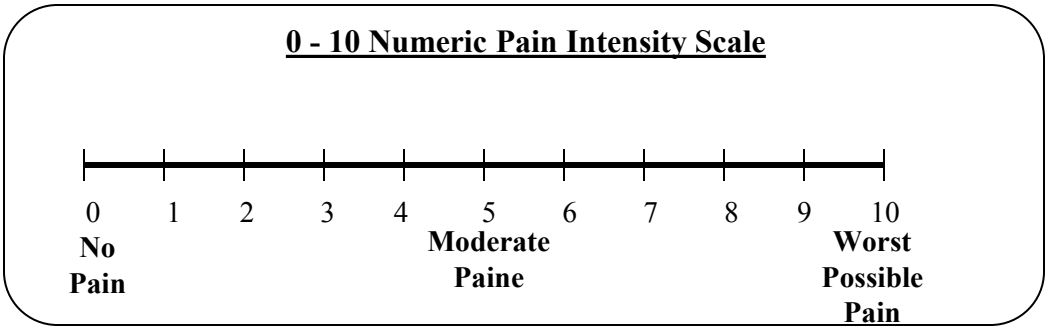
Indications: For procedures by physician (physician present) on intubated patients in the ICU



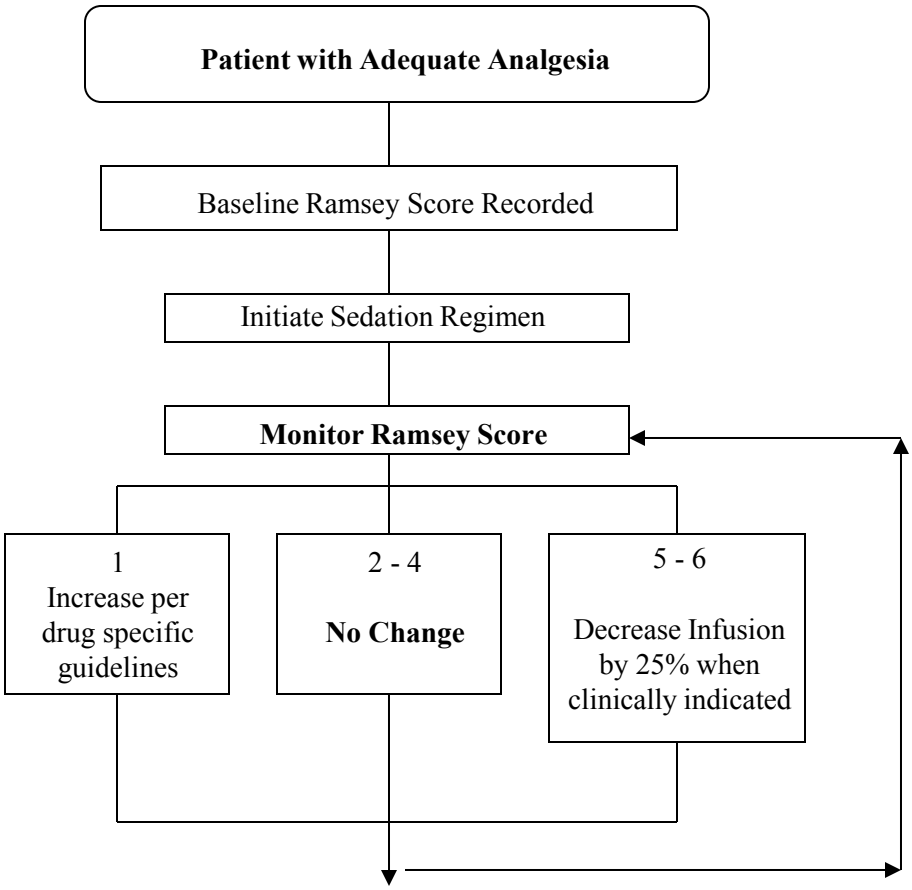
DOSAGE ADJUSTMENT GUIDELINES

ANALGESIA:
DOSAGE ADJUSTMENT GUIDELINES





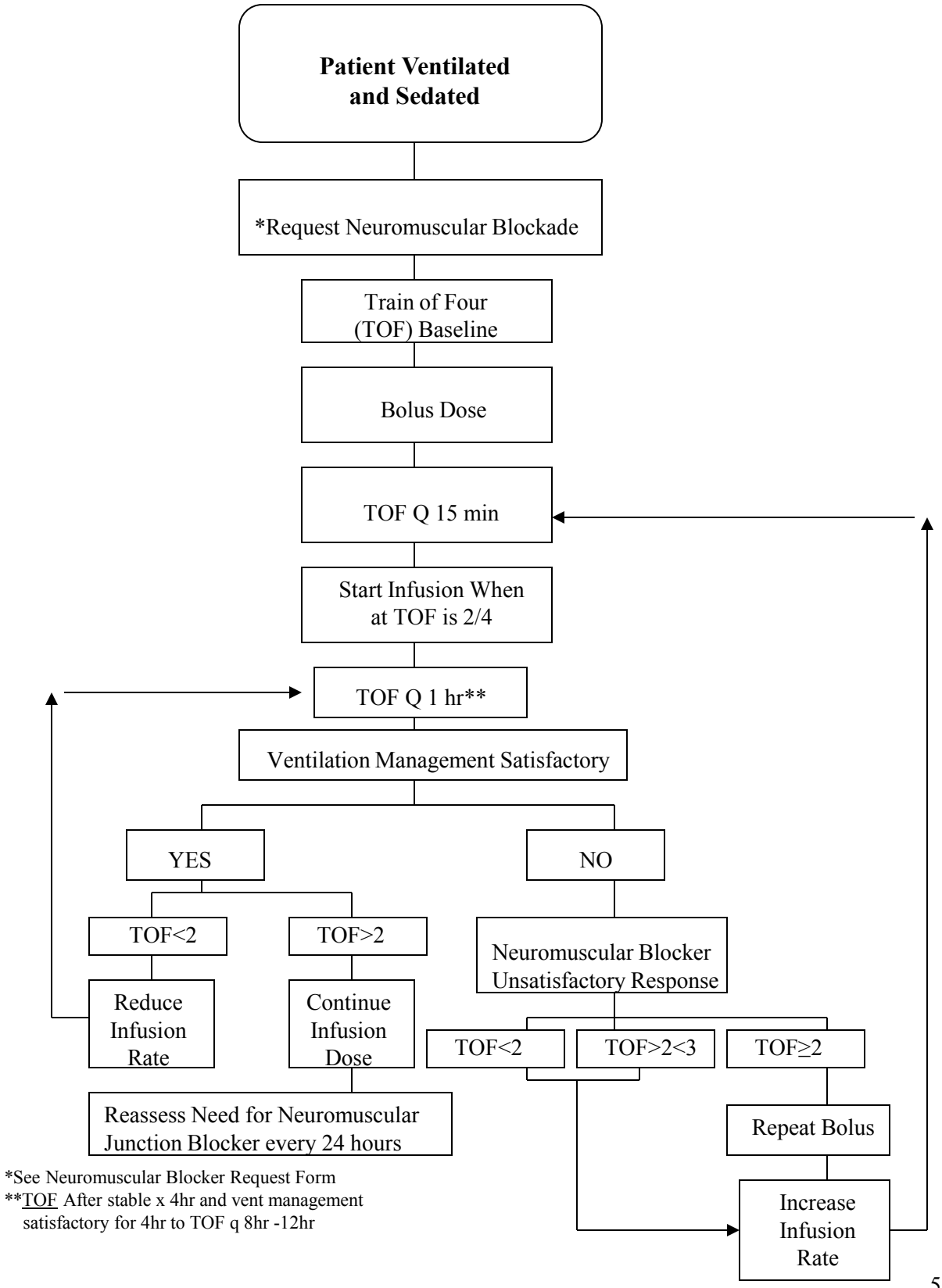
SEDATION:
DOSAGE ADJUSTMENT GUIDELINES



Ramsey Scale for Assessment of Sedation

Level/Score	Clinical Description
I	Anxious
II	Cooperative, oriented, tranquil
III	Responds only to verbal commands
IV	Asleep with brisk response to light stimulation
V	Asleep with sluggish response to stimulation
VI	Asleep with response to stimulation

NEUROMUSCULAR BLOCKERS: DOSAGE ADJUSTMENT GUIDELINES



*See Neuromuscular Blocker Request Form
**TOF After stable x 4hr and vent management satisfactory for 4hr to TOF q 8hr -12hr

APPENDIX

WEANING AND EXTUBATION GUIDELINES

POST-OP OPEN HEART

1. Patient is comfortable and awake
2 PEEP < 5
3. FIO_2<50%
4. No neuromuscular blockade:
   - Head lift sustained > 5 sec -OR- hold arm/hand over head > 30 sec
   - if patient weak, call anesthesia critical care
5. Able to protect airway
6. Follows simple commands
7. Minute ventilation <10 l/min on PSV≤10cm H_2O
8. Hemodynamically stable
   - no mechanical hemodynamic support, minimal inotrpes, no ongoing bleeding, no myocardial ischemia
9. Warm body (T>36.5° C)

PROCEDURAL GUIDELINES:

1. Minimize analgesic, maintain patient comfort (low morphine dose)
2. Stop sedatives (propofol,benzodiazepine)
3. Ventilator settings-
   - wean FIO_2 to <50%* maintaining O_2 Sat>95%
   - wean IMV to ≤ 4* maintaining $ETCO_2$< 55 or $PaCO_2$ <45
   - wean PSV to ≥ 10* maintaining $ETCO_2$ < 55 or $PaCO_2$ <45
4. Ask patient to follow commands
5. Document motor strength and level of consciousness
6. Extubate
   - place on 100% FIO_2
   - suction mouth/endotracheal tube
   - equipment available for reintubation (intubation box)

**NOTE*: Once the relationship between $PaCO_2$, PaO_2, and $ETCO_2/SaO_2$ has been established for each patient with blood gases, $ETCO_2$ and pulse, oximetry can be used thus avoiding multiple unnecessary blood gas measurements*

WEANING:

Patient on long term sedation or analgesia and/or patient has history of drug or alcohol abuse (see weaning algorithm, pg. 56)

WEANING ALGORITHM:

Patient on long-term sedation or analgesia, and/or history of drug or alcohol abuse