Anesthesiology and ERAS

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Associate Professor
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Improved Surgical Care and Recovery (ISCR)

• Note that ERAS is trade marked
• Improved Surgical Care and Recovery
  – This term is more useful because it underscores the importance of data driven optimization of care throughout the perioperative period
Collaboration is Key

• If you develop an ERAS protocol and anesthesia administers 8 liters of fluid during a colectomy, your effort has been wasted.
• Involvement and buy-in from a comprehensive representation of the care team from pre-op to discharge and beyond is a key to success.
Collaboration is Key!
Orthopedic Total Joint ERAS Team

<table>
<thead>
<tr>
<th>Anesthesia pre-op clinic</th>
<th>Physical therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anesthesia pain team</td>
<td></td>
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<tr>
<td>Nursing</td>
<td>Dietician</td>
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</tbody>
</table>
  • Joint Class           | Pharmacy         |
  • Pre-op                | Physician’s Assistants |
  • PACU                  |                   |
  • Floor                 | ERAS Consultant   |
| Orthopedic Surgery      |                  |
Anesthesiology and ERAS

• How can I contribute?
• Maintenance of normothermia
• Pre-op optimization
• Regional Anesthesia
• Non-narcotic/multimodal pain medications
• Goal Directed Fluid Therapy
Normothermia
AND I THOUGHT THAT WAS JUST A FIGURE OF SPEECH!
Hypothermia

• Negatively impacts perioperative outcomes:
  – Cardiac outcomes
  – Drug metabolism
  – Recovery time
  – Bleeding
  – Infection

Hypothermia

• There is frequently a significant opportunity for improvement during the time period from induction of anesthesia to incision

• General anesthesia results in a redistribution of blood i.e. heat from the core to the periphery

• The surface area to volume ratio of the extremities favors heat loss relative to the core, particularly in the setting of anesthetic induced vasodilation

• Evaporative cooling from alcohol containing prep solutions also contributes to heat loss
Hypothermia

- The OR should remain warm from induction of anesthesia and until the patient is fully draped and warming measures initiated.
- A brief warm period in the OR at the beginning of the case may avoid a longer warm period during the case.
Pre-op Clinic
Anesthesia Preoperative Clinic

• Numerous previous studies have evaluated the impact of an anesthesia preoperative clinic

• Anesthesia Pre-op Clinic positively impacts several important outcomes/indices
  – Reduced same day delays
  – Reduced cancellations
  – Improved patient satisfaction
  – Fewer tests ordered and fewer consults
  – Improved patient safety

Anesthesia Preoperative Clinic

• Utilization/implementation of an anesthesia preoperative clinic reduces cancellations

Pre-op Clinic Reduces Cancellations

<table>
<thead>
<tr>
<th>Year (April-March)</th>
<th>Total operating room cases</th>
<th>Total cancellations</th>
<th>Cancellations which could have been affected by preassessment</th>
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<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
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<tr>
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<tr>
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<td>289 (5.1)</td>
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<tr>
<td>2010</td>
<td>4981</td>
<td>427 (8.6)</td>
<td>177 (3.6)</td>
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<tr>
<td>P value</td>
<td></td>
<td>0.002</td>
<td>&lt;0.001</td>
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</tbody>
</table>

Preoperative Clinic Visits Reduce Operating Room Cancellations and Delays

Marla B. Ferschl, M.D.,* Avery Tung, M.D.,† BobbieJean Sweitzer, M.D.,† Dezheng Huo, M.D., Ph.D.,‡ David B. Glick, M.D., M.B.A.§

Background: Anesthesiologist-directed preoperative medicine clinics are used to prepare patients for the administration of anesthesia and surgery. Studies have shown that such a clinic reduces preoperative testing and consults, but few studies have examined the impact of the clinic on the day of surgery. The authors tested whether a visit to an anesthesia preoperative medicine clinic (APMC) would reduce day-of-surgery case cancellations and/or case delays.

Methods: The authors conducted a retrospective chart review of all surgical cases during a 6-month period at the University of Chicago Hospitals. Case cancellations and rates of first-startatory testing.4-7 In addition, visits to an anesthesia preoperative medicine clinic (APMC) have been shown to reduce the duration of hospital stay.8 Although these benefits of a preoperative clinic visit are known, the impact of a preoperative clinic visit on cancellations and delays on the day of surgery has been less well studied. We hypothesized that a preoperative clinic visit would decrease day-of-surgery case cancellations and reduce case delays. The financial impact of even small improve-
Results: A total of 6,524 eligible cases were included. In the same-day surgery suite, 98 of 1,164 (8.4%) APMC-evaluated patients were cancelled, as compared with 366 of 2,252 (16.2%) in the non-APMC group ($P < 0.001$). In the general operating rooms, 87 of 1,631 (5.3%) APMC-evaluated patients were cancelled, as compared with 192 of 1,477 (13.0%) patients without a clinic visit ($P < 0.001$). For both operating areas, APMC patients had a significantly earlier room entry time than patients not evaluated in the APMC.

Conclusions: An evaluation in the APMC can significantly impact case cancellations and delays on the day of surgery.
Pre-op Clinic

• In this study patients seen by the pre-op clinic were cancelled less often and experienced fewer delays despite higher ASA status
• There is a significant financial cost associated with case cancellations
• Reduced OR delays improves throughput and utilization

Anesthesiology 2005; 103:855–9
Regional Anesthesia and Nerve Blocks
Advantages of Regional Anesthesia

• Improved Pain Control
• Improved Patient Satisfaction
• Earlier ROBF (Return of Bowel Function)
• Shortened Length of Stay
• Decreased transition of acute pain to chronic pain
• Reduced narcotic side effects and decreased risk of tolerance/dependence
• In general, improved surgical outcomes i.e. ROM post TKA
Regional Anesthesia

• Facilitates earlier ROBF
  – Narcotic sparring effect
  – Sympathectomy
Regional Anesthesia

• Major abdominal cases
  – Epidural or continuous paravertebral blocks
  – LA only vs LA + additives

• Minor abdominal & laparoscopic cases
  – Pre-op TAB block or Quadratus Lumborum Block
  • Continuous vs single shot

• Protocolize utilization!!!
Quadratus Lumborum Block
QL Block
QL Block

**FIGURE 4.** Dermatomal effects of QLB and lateral TAPB. The bar shows the success rate of each block at the dermatome.
Narcotics are Bad Drugs

- Adverse effects
- Hyperalgesia
- Dependence/Abuse
Adverse Effects of Narcotics

- Respiratory Depression
- PONV
- Pruritus
- Ileus/Constipation
- Prolonged recovery
- Sedation
- Development of Acute Tolerance
- Cancer Recurrence*
Opioid Induced Hyperalgesia

• Hyperalgesia
  – An exaggerated pain response to a normally painful stimulus (Barish 6th edition)

• Opioid Induced Hyperalgesia (OIH)
  – “a state of nociceptive sensitization caused by exposure to opioids”
  – Caused by neuronal changes in the CNS that increase activity in pro-nociceptive pathways

• Results in decreased effectiveness of narcotics and may result in a paradoxical response
Opioid Induced Hyperalgesia

doi:10.1093/bja/oeu137

Opioid-induced hyperalgesia in patients after surgery:  
a systematic review and a meta-analysis

D. Fletcher1,2,3* and V. Martinez1,2,3

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2 INSERM, U-987, Hôpital Ambroise Paré, Centre d’Evaluation et de Traitement de la Douleur, Garches F-92100, France  
3 Université Versailles Saint-Quentin, Garches F-78035, France  
* Corresponding author. E-mail: dominique.fletcher@rpc.aphp.fr
Opioid Induced Hyperalgesia

**Results.** Twenty-seven studies involving 1494 patients were included in the analysis. Patients treated with high intra-operative doses of opioid reported higher postoperative pain intensity than the reference groups (MD: 9.4 cm; 95% CI: 4.4, 14.5) at 1 h, (MD: 7.1 cm; 95% CI: 2.8, 11.3) at 4 h, and (MD: 3 cm; 95% CI: 0.4, 5.6) at 24 h on a 100 cm visual analogue scale. They also showed higher postoperative morphine use after 24 h (SMD: 0.7; 95% CI: 0.37, 1.02). There was no difference in the incidences of nausea, vomiting, and drowsiness. These results were mainly associated with the use of remifentanil. The impact of other opioids is less clear because of limited data.

**Remifentanil-induced hyperalgesia can be measured in patients after surgery**

Our results confirm that postoperative hyperalgesia can be detected in patients receiving high doses of intraoperative remifentanil. Six studies have measured the effects of intra-
The Cost of Satisfaction

A National Study of Patient Satisfaction, Health Care Utilization, Expenditures, and Mortality

Joshua J. Fenion, MD, MPH; Anthony F. Jerant, MD;
Klon D. Bertakis, MD, MPH; Peter Franks, MD

Background: Patient satisfaction is a widely used health care quality metric. However, the relationship between patient satisfaction and health care utilization, expenditures, and outcomes remains ill defined.

Methods: We conducted a prospective cohort study of adult respondents (N = 51,946) to the 2000 through 2007 national Medical Expenditure Panel Survey, including 2 years of panel data for each patient and mortality follow-up data through December 31, 2006, for the 2000 through 2003 subsample (n = 36,428). Year 1 patient satisfaction was assessed using 5 items from the Consumer Assessment of Health Plans Survey. We estimated the adjusted associations between year 1 patient satisfaction and year 2 health care utilization (any emergency department visits and any inpatient admissions), year 2 health care expenditures (total and for prescription drugs), and mortality during a mean follow-up duration of 3.9 years.

Conclusion: In a nationally representative sample, higher patient satisfaction was associated with less emergency department use but with greater inpatient use, higher overall health care and prescription drug expenditures, and increased mortality.

ORIGINAL INVESTIGATION

Changing What's Possible.
Archives of Internal Medicine
2012
The Cost of Satisfaction

**Conclusion:** In a nationally representative sample, higher patient satisfaction was associated with less emergency department use but with greater inpatient use, higher overall health care and prescription drug expenditures, and increased mortality.
Ca^{2+} → Primary afferent terminal → G protein → Morphine → μ-Opioid receptor → Dorsal horn neuron
Multimodal Analgesics

- Local Anesthetics
- NSAIDS
- Selective COX inhibitors
- NMDA Antagonists
- GABA Analogues
- Alpha-2 agonists
- Steroids
- Other
  - Magnesium
  - Neostigmine
Multimodal Analgesia

• Key components of a multimodal pain management protocol (in addition to regional anesthesia):
  – Acetaminophen
  – Gabapentin
  – Ketorolac
  – +/- Celecoxib

• Intraoperative multimodal analgesics:
  – Ketamine
  – Dexmedetomidine
  – Dexamethasone
  – Magnesium
  – Lidocaine
Acetaminophen

• Intravenous vs Oral
  – There is a mountain of anecdotal evidence that’s implies IV is superior to PO
    • Unsubstantiated by data
    • Intravenous is significantly more expensive
  – My recommendation is to use oral in lieu of IV whenever possible
    • Including the initial pre-op dose

• Must be scheduled, not PRN
IV vs Oral

Oral demonstrated non-inferiority

Figure 1. Mean scores of pain relief (PR). Abscissa: time (h); ordinate: pain relief (mean score). **P < 0.01, acetaminophen versus placebo and propacetamol versus placebo; ¥P < 0.05, acetaminophen versus propacetamol. ▲ = acetaminophen; ○ = propacetamol; □ = placebo.

Prospective, Randomized, Double-blinded RCT
Dexmedetomidine

• Highly selective alpha-2 agonist
  – Dexmedetomidine is roughly 8x more selective for alpha-2 relative to clonidine
  – Ratio alpha-2:alpha-1
    • Clonidine 220:1
    • Dex 1620:1
• Causes sedation, analgesia, anxiolysis, and sympatholysis
• Provides sedation and analgesia without respiratory depression
• Diminishes the hemodynamic response to surgical stimulation
• Reduce anesthetic and opioid requirements
Dexmedetomidine and Lap Gastric Bypass

- Dholakia et al performed a retrospective chart review of patients undergoing lap gastric bypass and lap gastric banding procedures.
- Consecutive patients immediately prior to and following implementation of a new clinical protocol instituting the use of dexmedetomidine were examined.
- Investigators compared the following from each group:
  - Length of stay
  - Narcotic use
  - Pain Scores
  - Antiemetic use
  - Perioperative vital signs
- Patients suffering major complications and those on chronic narcotic therapy were excluded.
Results

• Lap Gastric Bypass
  – Patients receiving dexmedetomidine
    • Required lower doses of narcotics to achieve equal pain control (total morphine dose 66mg vs 130mg p=0.04)
    • Meet discharge criteria more often on POD 1 and were discharged earlier than patients not receiving dexmedetomidine (LOS 1.4 vs 1.9 days, p=0.02)(D/C criteria met POD 1 61% vs 29%, p=0.02)
  – There was no significant difference in vital signs (HR, SBP, RR) in patients who received dexmedetomidine vs those who did not
  – There was no significant reduction in the usage of antiemetics in patients who received dexmedetomidine vs those who did not
Goal Directed Fluid Administration
Fluid Administration

• Historically, we were guessing
  – 4-2-1 + insensible losses + UOP + 3x EBL
  – CVP
• Historically, we gave too much fluid
Goal Directed Fluid Therapy

• There has to be a better way
• Principles
  – Arterial waveform analysis
    • Pulse pressure variation
    • Sophisticated algorithm
    • Esophageal dopplar
  – Chamber volumes and filling pressures
    • TEE
    • TTE/POCUS
Goal Directed Fluid Therapy

• Devices
  – Arterial waveform analysis
    • Flotrac, LiDCO, esophageal dopplar
  – Cardiac Echocardiography
    • TEE
    • TTE/POCUS
Changing What’s Possible.
Stroke Volume Variation

- Useful for patients ventilated with positive pressure, in sinus rhythm, and hypotensive
- Positive pressure ventilation i.e. positive intra-thoracic pressure impedes venous return and, therefore RA/RV filling
- In a hypotensive patient, in sinus rhythm, and ventilated with positive pressure, SVV is a useful indicator of volume status
- If the SVV is greater than 13% in this setting, the hypotension is likely due to hypovolemia
- If the SVV is less than 13% in this setting, the patient is likely euvolemic and other causes of hypotension should be considered
Stroke Volume Variation (SVV)

SVV as it isTraditionally Calculated

\[ SVV = \frac{SV_{\text{max}} - SV_{\text{min}}}{SV_{\text{mean}}} \]
SVV Algorithm

Volume Responsive SVV >13%

- YES
  - Volume Challenge
  - SVI Normal (40-50)
  - SVI Low (<40)
  - SVI High (>50)
  - Pressor
  - Inotrope
  - Diuretic

- NO

Arterial Waveform Analysis

• More sophisticated analysis of waveform morphology is possible

• For example:
  – Upward slope corresponds to contractility
  – AUC corresponds to stroke volume
Perioperative Fluid Administration in Pancreatic Surgery: a Comparison of Three Regimens

Leonardo Gottin1 · Ahlise Martini1 · Nicola Menestrina1 · Vittorio Schweiger1 · Giuseppe Maisonneuve1 · Katia Donadello2 · Enrico Polati3

Received: 27 September 2018 / Accepted: 8 February 2019 © 2019 The Society for Surgery of the Alimentary Tract

Abstract

Background Optimization of perioperative fluid management is a controversial issue. Weight-adjusted, fixed fluid strategies do not take into account patient hemodynamic status, so that individualized strategies guided by relevant variables may be preferable. We studied this issue in patients undergoing pancreatic surgery within our institutions.

Methods All patients who underwent a laparotomy for pancreatic cancer during a 5-month period at our hospital (AOU of Verona, Italy) were eligible to be included in this prospective, observational study. According to the responsible anesthesiologist’s free choice, patients received, during surgery, either liberal (12 ml/kg/h) or restricted (4 ml/kg/h) fluid-volume weight-guided replacement fluids or goal-directed (GD) fluid replacement using stroke volume variation (SVV) determined by the FloTrac Vigileo device.

Results Eighty-six patients were included: 29 in the liberal group, 23 in the restricted group, and 34 in the GD group. The mean duration of surgery was 6.4 (7.1) h. Patients in the liberal group received more perioperative fluid than those in the GD and restricted groups. Nearly one third of all patients had a major complication, including delayed enteral feeding, and presented a longer duration of hospital stay. Despite the biases related to our limited cohort, there were significantly fewer postoperative complications (such as postoperative fistulas, abdominal collection, and hemorrhage) in the restricted and GD groups of patients than in the liberal one.

Conclusion In patients undergoing pancreatic surgery, a restricted or individually guided GD strategy for management of perioperative fluids can result in fewer complications than a liberal fluid strategy. Larger and randomized investigations are warranted to confirm these data on this domain.

Keywords: Fluid strategy · Volume replacement · Crystalloids · Colloids · Abdominal surgery · Postoperative complications

Introduction

Despite recent progress, major abdominal surgery continues to be shaded by high morbidity and mortality rates, representing a tough challenge for both surgeons and anesthesiologists. Various complications may arise in the postoperative period, but they all recognize common pathways related to low perfusion and tissue oxygenation with subsequent reduced microvascular flow, leading to organ dysfunction. Optimal fluid management in the perioperative period remains a controversial issue. When a fluid-volume strategy is applied, at least in major abdominal surgery, a restrictive approach may be associated with fewer postoperative complications, less impairment of gut motility, and improved anastomotic healing. In contrast, some studies have suggested that more liberal
Standardization of Practices

Figure 2: Fluid administration by surgical procedures. Corrected crystalloid infusion rates for procedures at both UCI and VU. Each boxplot is the median and range. For most procedures, about 50% of patients received between 4 and 10 ml kg⁻¹ h⁻¹ crystalloid; the other 50% obviously fell outside this wide range. Of note, UCI has a specific protocol for crystalloid administration during prostatectomies, and this group had the smallest range of any of the analysed procedures, suggesting that directed protocols can be effective in reducing variability.
ENT Free Flaps
I LOVE IT WHEN

A PLAN COMES
TOGETHER
Free Flaps

• Vasoactive medications decrease graft survival
• Hypotension decreases graft survival
• Management of hypotension with excess fluid administration worsens outcomes
• Catch 22?
Flo-Trac Intra-op Treatment Algorithm

Hypotensive?*
(MAP<75 or >10% below baseline if higher than 75)

SVV>13?

C.I. < 3.0

Y

250cc IVF bolus, then re-assess

N

C.I. < 3.0

Y

Dobuta gtt, re-assess in 10 min

N

Re-assess in 10 minutes

SVR<800

Epi gtt, re-assess in 10 min**

N

Phenylephrine gtt, then re-assess

Y

Re-assess in 10 minutes

*Note: Patient to be ventilated at 8cc/kg throughout case as long as peak airway pressure is < 35 cm H₂O.

**Note: If HR<60, may give glycopyrrolate 0.4-1.0mg IV prior to initiating epi infusion.

COLLOIDS: [(30)*(TBW*EBV)-((serum albumin (GM/dL)*10)*(TBW*EBV))]=amt of 25% Alb needed
So, does it work?

TABLE 3. Postoperative patient characteristics and outcomes.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Control group (n = 47)</th>
<th>Treatment group (n = 47)</th>
<th>p value</th>
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</thead>
<tbody>
<tr>
<td>ICU length of stay, h,</td>
<td>58.3 (63.6)</td>
<td>33.7 (36.7)</td>
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<td>intent-to-treat</td>
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<td>2.64 (2.49)</td>
<td>1.88 (2.01)</td>
<td>.104</td>
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<tr>
<td>Hospital length of stay, d</td>
<td>10.8 (7.65)</td>
<td>9.11 (5.76)</td>
<td>.221</td>
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<tr>
<td>Reoperation</td>
<td>8 (17.4)</td>
<td>4 (10.0)</td>
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<tr>
<td>Flap failure</td>
<td>4 (9.30)</td>
<td>2 (5.88)</td>
<td>.681</td>
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<td>Flap death</td>
<td>3 (6.82)</td>
<td>2 (5.00)</td>
<td>1.00</td>
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<tr>
<td>ICU ventilation</td>
<td>18 (52.9)</td>
<td>9 (31.0)</td>
<td>.125</td>
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<tr>
<td>Ventilator days</td>
<td>1.72 (1.82)</td>
<td>0.81 (1.30)</td>
<td>.006</td>
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<tr>
<td>Direct cost, $</td>
<td>30,047 (14,216)</td>
<td>26,509 (10,577)</td>
<td>.174</td>
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</table>
So, does it work?

<table>
<thead>
<tr>
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<th>Treatment (n=47)</th>
<th>p</th>
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<tr>
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<td>0.81 (1.30)</td>
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<tr>
<td>Average Supply Cost</td>
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<td>OR Cost</td>
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<td>6340.3 (3952.3)</td>
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<td>403.7 (314.2)</td>
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## COST DATA
(83/94 patients Collected and Reconciled)

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<th>Average of DIRECT COST</th>
<th>Average of TOTAL COST</th>
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<tr>
<td>Baseline</td>
<td>$33,755</td>
<td>$53,884</td>
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<tr>
<td>Control</td>
<td>$30,047</td>
<td>$54,912</td>
</tr>
<tr>
<td>Treatment</td>
<td>$26,509</td>
<td>$43,161</td>
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</table>
Summary Recommendations

• Establish ERAS Protocols
  – Monitor protocol compliance!
• Do not administer/prescribe narcotics
• Utilize non-narcotic medications from multiple classes
• Practice goal directed fluid administration
• Avoid hypothermia
• Establish and utilize an anesthesia preop clinic
• Establish and utilize a regional anesthesia acute pain service