New Directions in Anesthesia Care

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What's New?

- Economics of Anesthesia
  - Bundled payments
  - ACO's
  - Added value
  - Surgical Home
- Drugs:
  - Some new, some old
- Techniques
  - Anesthetic techniques and outcomes
- Management
  - Managing anesthetic processes.

Coordinated Care

latimes.com/business/la-fi-calif-health-costs-20130226,0,6769820.story

Coordinated healthcare could save California $110 billion, group says

12:05 AM PST, February 26, 2013

California could cut $110 billion in healthcare spending over the next decade, saving the average household $800 a year, by quickly moving away from conventional fee-for-service medicine and embracing more coordinated care, a new report says.

These findings released Tuesday come from the Berkeley Forum, a new group of healthcare executives, state officials and academics that studied California's healthcare market for the last year in hopes of finding ways to make care better and more affordable. The main recommendations are not entirely new, and these shifts are already underway in response to the federal healthcare law and pressure from employers to tame runaway medical costs.

Why Discuss Costs?

- Charges do not equal costs or revenue.
- Contracted care and Medicare pay fixed rate.
  - Profits = reimbursement - costs.
- Costs are used to justify reimbursement.
- All physicians will be judged on quality and cost.
- Costs assist with decisions about clinical practice.
  - Reducing complications also reduces costs.
- When choosing two techniques or drugs with equal effectiveness choose the least expensive.

Methods of Analyzing Costs

- Cost-minimization
  - Finds the least expensive drug.
  - Assumes that outcomes are the same.
- Cost-effectiveness.
  - Compares drugs per unit of effect.
- Cost-utility.
  - Compares cost for quality of life issues or patient preference.
- Cost-benefit.
  - Compare drugs for unrelated outcomes if an economic price can be put on the outcomes.

On The Way to Healthcare Reform . . .

- Costs changed.
- Drug costs decreased.
  - Less of a contributor to overall costs.
  - Studies from the 90's are not applicable in 2013.
- Quantity of cost studies decreased.
  - Complexity of cost studies is better appreciated.
  - Costs depend more on indirect effects of anesthetic choices.
- Personnel costs continue to increase and are a greater percentage of total costs today.
Where Are The Cost Savings?

- Anesthesia expenses are 5.6% of hospital costs for a surgical stay.
  - Includes depreciated equipment and anesthesia support.
  - Drugs are an even smaller percentage of costs.
- Processes are more costly than drugs.
- The greatest potential for cost savings is through improved perioperative efficiency.
- Personnel salaries make up the majority of costs.

Macario et al. Anesthesiology. December 1995 pp 1138-44

Measuring Costs Should Be Easy. . .

. . . But Isn’t.

- Different types of cost:
  - Fixed vs. variable.
  - Total costs.
    - Combination of fixed and variable.
  - Marginal costs.
    - Cost of treating one more patient.
  - Average costs.
    - Decreases as add more patients.
- Different perspective of cost:
  - Provider – payer – societal.

Sperry: Anesthesiology; 1997 86: 5 pp 1197-1205.

Role of Anesthesiology

- Patient preparation
- OR efficiency
- Management of OR processes
- OR safety
- Immediate post-operative care
- Extended post-operative care
  - ICU
  - Discharge for outpatient

Ideal Anesthetic

- Agents that can be quickly titrated.
  - Respond to changing intraoperative conditions.
  - Rapid emergence and discharge.
- Drugs that reduce side effects.
  - Prevent nausea and vomiting.
  - Fewer side effects will speed recovery.
- Drugs and techniques that decrease overall costs.
  - Evaluate costs across the entire facility.
  - Don’t sacrifice quality.

Costs We Can Control

Directly –
- Anesthetic agents and perioperative drugs.
- Supplies used in the operating rooms.
- Equipment and monitoring.
- 50% of intraoperative anesthesia costs are determined by choice of agent and technique.

Indirectly –
- Non-operative OR time:
  - Turnover, patient preparation and wake-up time.
- Time and supplies used in PACU.
- Nursing and support staff salary expenses.
- Expenses to stock items.
- Acquisition cost of equipment.
Adding Value to Perioperative Care

• Increase productivity.
  • Do more cases without increasing resources.
  • Do more cases in a single day.
  • Do more cases with same staff.
• Decrease costs.
  • Reduce staffing.
  • Decrease supplies consumed.
  • Use less expensive drugs.
  • Decrease equipment usage.

Patient Valuation of Adverse Outcomes

• 101 patients asked to order 10 possible complications.
• In order of importance:
  1. Vomiting
  2. Gagging on ETT
  3. Pain
  4. Nausea
  5. Recall without pain
  6. Residual weakness
  7. Shivering
  8. Sore throat
  9. Somnolence
  10. Normal recovery


What would you pay for no PONV?

• 80 patients for outpatient surgery under GA.
• Questionnaire administered in PACU prior to discharge.
  * 8 iterations of computerized questions.
  * Average patient - $56 to completely avoid PONV.
  * If patient had nausea - $73.
  * Patients who had vomiting - $100.
  * If insurance paid, then amount increased avg. 68%.
• Patients place a high value on avoiding PONV.
  * Gan TJ, Sloan F, et al. Anesth Analg 01; 92: 393-

Expanding Choice of Antiemetics

• Four approved 5-HT3 antagonists for PONV treatment.
  • Ondansetron (Zofran).
  • Dolasetron (Anzemet).
  • Granisetron (Kytril).
  • Palonosetron (Aloxi).
• New class of drugs: NK1 antagonists.
• Older generics: droperidol, dexamethasone, scopolamine, promethazine, prochlorperazine, dimenhydrinate.

Palonosetron

• New 5-HT3 antagonist
• Greater binding affinity
  * May be better for chemotherapy induced nausea.
• Longer half life
  * Oncology studies demonstrate 5 days of effectiveness
• Study looked at 544 female patients for elective gynecologic or breast surgery.
  • 3 doses of palonosetron.
  • 72 hour observation.


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Palonosetron
NK-1 Antagonists

- NK1 receptor is a mediator for substance P.
- Substance P is key to central emetic circuitry.
- NK1 antagonists work on nucleus tractus solitarius neurons in central emetic circuitry.
- Also possible peripheral site activity.
- GI tract receptors
- Vagal terminals in the GI tract
- Decrease intensity of emetic afferent messages sent to the medullary emetic centers.
- Similar to 5-HT3 antagonists.

- May be better than 5HT3’s at preventing vomiting.
- Aprepitant improved vomiting but not nausea and need for rescue vs ondansetron
  - Habib et al. Anesth Analg 2011;112:813–8
- Casopitant also improved vomiting but not nausea.
- Rolapitant has a 7 day half-life
- Measured out to 120 hours.
- Less emesis than placebo but not more than ondansetron (although trended toward significant)
  - Gan et al. Anesth Analg 2011;112:804–12

Droperidol Black Box Warning

- FDA issued the warning in December 2001.
- Deaths associated with QTc prolongation resulting in Torsades de Pointes.
- Warning states that droperidol should only be used when other first line therapy fails.
- All patients should have a 12-lead ECG checked for prolonged QT interval.
- ECG monitoring should be continued for 2-3 hours post administration.

Is Droperidol That Bad?

- 9 case reports led to the warning.
  - Huge denominator of cases with no adverse effects.
- 4 deaths occurred with 2.5 mg dose.
- 2 arrests in patients receiving 1 mg.
- ASA representatives currently working with FDA to have black box warning reduced in severity.
- CA Dept of Public Health requires a facility wide protocol for the safe administration of droperidol.

Risk of Low Dose Droperidol

- New retrospective study of 20,122 patients.
- 35,536 administrations of 0.625 mg dose.
- Results:
  - 4 patients had VT
    - No patients had polymorphic VT.
    - 3 had history of VT prior to droperidol
    - 1 had hypertrophic obstructive cardiomyopathy.
  - 8 deaths, all on palliative care.
  - 523 with prolonged QT - 0 incidence of VT.
  - No increase in polymorphic VT with low dose.
  - Nuttall et al. Anesthesiology. 2013; 118:2, 382-6

Zofran and Prolonged QT

- Released on 9/15/2011.
- Zofran should be avoided in patients with long QT.
- ECG monitoring recommended in patients at risk.
Research Fraud

• Dr. Yoshitaka Fujii published on PONV.
  • 172 articles out of 212 fabricated.
  • 3 were real studies.
• Results of studies:
  • Increased effectiveness of granisetron and ramosetron.
  • Supported propofol having long duration of antiemetic effectiveness.
  • Dexamethasone effective only with 8 mg dose.
  • Reduced effectiveness of droperidol and metoclopramide as comparators.
  • Some meta-analyses effected.


Start Treating PONV In The OR

• Using multimodal therapy tailored to the patient and the procedure.
  • Aggressively hydrate patients.
    • 20 ml/kg IV during case or in early post-op.
  • Avoid:
    • GA
    • Neuromuscular blockers and reversal agents
    • Positive pressure ventilation and intubation.
  • Plan ahead to control post-op pain.
    • If possible use non-narcotic analgesics.
    • Good pain control with narcotics can decrease nausea.

Choosing the Right Drugs

• Use generic drugs for routine prophylaxis.
  • Give dexamethasone early.
  • Droperidol works best at end of case.
  • In outpatient setting may want to give it early.
  • Avoid the sedative effects.
• Use 5-HT₃ antagonists for rescue therapy.
  • or 5-HT₃ antagonists should be the third intra-op drug.
  • Don’t repeatedly dose 5-HT₃ antagonists.
  • Switch to another class for rescue.

Nitrous Oxide

• Advantages:
  • Amnesia and analgesia
  • Reduced anesthetic and opioid requirements
  • Rapid termination of action
• Disadvantages
  • Increase PONV?
  • Expand gas in closed air spaces
    • Limiting use in abdominal and ENT surgery

Important Articles on PONV

Society for Ambulatory Anesthesia Guidelines for the Management of Postoperative Nausea and Vomiting


Six Intervention Trial

Nitrous Oxide and PONV

- 33 separate trials that compared nitrous v no-nitrous groups.
- Avoiding N\textsubscript{2}O reduced the risk of PONV by 20%.
  - 33% v 27%.
  - 12 studies showed no difference.
  - Stronger effect in women.
  - No difference between groups for laparoscopy.
  - Administration of propofol eliminated the difference.
- Almost all studies > 10 years old.
- Leaves question unanswered.

Nitrous Oxide and Opioid Induced Hyperalgesia

- Opioids may reduce nociceptive thresholds
  - Mediated via NMDA-dependent pain pathways.
- Nitrous is an NMDA antagonist.
- 50 patients randomized to N\textsubscript{2}O 70% v O\textsubscript{2}.
  - BIS titrated propofol and remifentanil anesthetic.
- Results:
  - No immediate difference in post-op pain scores.
  - Decrease in response to noxious stimuli at 12-18 h post-op.

Nitrous Oxide and Emergence

- Study looking at second gas effect on emergence.
- 20 patients having sevoflurane GA
- Nitrous group given 66% N\textsubscript{2}O
- Measured arterial blood and end tidal gas.
- Results:
  - Early rapid diffusion of N\textsubscript{2}O accelerated the reduction in partial pressure of the volatile agent.
  - Sevoflurane 35% higher in control group at 5 min.
  - Reduced time to eye opening (8.7 v 10.1 m)
  - Reduced time to extubation (11.0 v 13.2 m)

N\textsubscript{2}O Second Gas Effect

- Arterial relative ratio to anesthetic baseline concentrations.

Peripheral Regional Anesthesia

- Less non-surgical time spent in OR.
- Fewer side effects from anesthesia.
- Faster discharge.
  - 40 min quicker for knees, 70 min for shoulders.
  - Discharge with block still functional.
  - Discharge patient with protected limb and instructions.
  - Provide contact phone number for first 24 hours.
- Decreased unplanned admission rate.
- Increased cognitive function for 3+ days post-op.

Advantages to Regional Anesthesia

- Avoids airway manipulation
- Reduces perioperative opioid requirements
- Reduces PACU stay
  - In fast track situation can bypass PACU stay
- Reduces postoperative complication rate
  - Drowsiness (assumes minimal intraop sedation)
  - Pain and nausea
- Reduces time to home-readiness
Choice of Anesthetic Technique

• MAC with local:
  • Decreased PONV.
  • Faster time to discharge than general.
  • May not save on pharmaceutical costs.
• Spinal:
  • Complications of TNS and PDPH.
  • Prolonged time to discharge.
• Peripheral regional:
  • Decreased PONV.
  • Faster time to discharge than spinal or general.

— Enneking FK, Wedel DJ. Anesth Analg 00; 90: 1-2

Effect of Anesthetic Technique

• Studied 16,411 patients.
• GA stayed longer than MAC.
• Type of surgery.
  • GA ophthalmic operations had prolonged stay.
  • MAC patients with ENT/dental procedures prolonged stay.
• Complications:
  • Pain and PONV.
  • Increasing age increased length of stay.
  • Smokers left earlier.
  • Could be due to antiemetic effect.

Chung F, Mezei G. Anesth Analg 99; 89: 1352-9

Preoperative Dexamethasone

• Lap cholecystectomy.
  • Placebo v Dexamethasone 8 mg, 60 m preop.
• Endpoint: quality of recovery scoring system.
  • Physical, emotional, psychological, pain factors.
• QOR score higher on day 1 in dex group.
• Significant reduction in pain for POD1.
• Improved early recovery.
• Reduced hospital stay.


Periop Dexamethasone and Pain

• Meta-analysis of randomized trials.
• 3 dosage groups:
  • low dose < 0.1 mg/kg.
  • intermediate does 0.11-0.2 mg/kg.
  • high dose > 0.2 mg/kg.
• Postop pain scores reduced at all doses.
• Opioid consumption reduced in intermediate and high dose groups.
• Effective adjunct for reducing postop pain.


Meta-Analysis of Maintenance Agents

• Early recovery statistically different but only marginally quicker in desflurane and sevoflurane compared to isoflurane or propofol.
  • Magnitude of difference: less than 5 minutes.
  • Desflurane only 1 min faster than sevoflurane.
  • Not clinically relevant.
• Little significant difference in home readiness.
  • Sevoflurane slightly faster than isoflurane (5 min).
  • Propofol 10-15 min advantage over sevo and isoflurane.
• PONV less likely with propofol.


CO₂ and Inhalation Anesthesia

• Balance between increasing ventilation to remove volatile anesthetics and emergence.
  • Increased ventilation produces hypocapnia.
  • Hypocapnia reduces cerebral perfusion.
  • Decreasing minute ventilation decreases washout of inhaled anesthetic.
• Ideally: Normocarbia and increased alveolar ventilation.
  • Add CO₂ to the circuit
  • Reservoir in circuit to induce rebreathing.
  • Mild hypercapnia during surgery.

— Joshi. Anesth Analg 2012; 114: 933-4
Improved Tissue Oxygenation

- Study in morbidly obese patients.
  - Resistant to traditional measures that improve tissue oxygenation.
- Mild hypercapnia (50mm Hg) increases cardiac index and peripheral vasodilation.
  - Hypercapnic patients received fewer colloids.
  - No hemodynamic changes between groups.
  - PaO$_2$ same in two groups.
  - PsqO$_2$ significantly greater in hypercapnia group.
  - 78mm Hg vs 56.
  - Significantly less use of colloids during surgery.
  - Hager et al. Anesth Analg 2006; 103: 677-81

Accelerated Recovery

- Rebreathing device to increase EtCO$_2$ and increase minute ventilation.
- EtCO$_2$ kept less than 55.
- Reduced emergence times:
  - 52% for Sevoflurane.
  - 64% for Desflurane.

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Accelerated Recovery

- Compared high gas flows to an isocapnic system.
- PetCO$_2$ maintained between 45-50 mm Hg.
- Sevoflurane anesthetic.

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Changing the Practice

- Use of feedback to modify anesthetic choices.
- 27 residents received written feedback on cost of their anesthetic.
- Feedback group had significantly lower costs.
- 3 months later costs had rebounded to pre-study levels.

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Changing the Practice

- Anesthesia record analysis provided feedback to attending physicians.
- Group meetings identified changes in practice.
- Continuous feedback to physicians.
- Saved $32 per case over 3 years.

Operative Teams

- Fixed teams can improve outcomes.
  - Reduced procedure duration
    - Improved even within a single day by 5%
    - Surgical time improved by 12%
  - Improved teamwork
  - Improved safety
  - Maintain patient outcomes
  - Study was limited by measuring single-day teams
  - Tasks became standardized.
  - Patient outcomes trended toward improvement.
- Stepniak et al. Anes Ana lg 2012; 115; 6: 1384-92

**Drug Choices**

- Drug costs can not be accurately compared on a per case basis.
- Greater accuracy when calculated per unit.
  
- Practice guidelines can assist.
  - Posted at the pharmacy.
  - Expensive drugs could only be obtained by attending physicians.
  - Drug costs decreased from $56 to $32/case.
- No change in outcomes.
  
  – Lubarsky et al. Anesthesiology 997; 86: 1145-60.

**Managing Your Anesthetics**

- Anesthetic choices are key to successful perioperative care.
- Aggressively use techniques that:
  - Improve patient outcomes.
  - Decrease use of perioperative resources.
- New drugs need to be carefully evaluated.
  - Pharmaceutical costs need to be judged against gains in personnel costs and facility savings.
- Old drugs are being reevaluated and have benefits that have been overlooked.
- Standardize your changes so they apply to all patients.

**The End Result**

![Hospital Room Image]