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Drs Katz & Sinha have no affiliation with the manufacturer of any commercial product or provider of any commercial service discussed in this CME activity.

Peri-operative management strategies & chronic post-surgical pain

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May 28th, 2009

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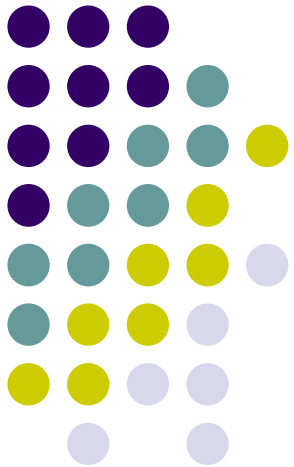
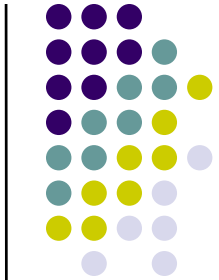


Aims

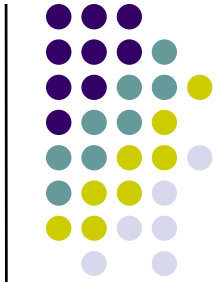


- Define & discuss the peri-op anaesthesia and pain management with a view to chronicity.
  - Factors affecting pain perception
  - Risk factors for chronic post-surgical pain [CPSP]
- Implementation of regional anaesthesia based multi-modal pain management therapy with dosing regimes individualised to optimise efficacy while limiting risks of adverse effects.
- Chronic opiate consumption; A complex challenge - more severe acute pain than opiate naïve patients
  - Lower pain threshold and higher pain sensitivity [1]
  - Constant opiate receptor activity produces hyper-algesia
  - Discuss mechanisms of tolerance & hyperalgesia

Definitions; ‘Chronicity’ of pain

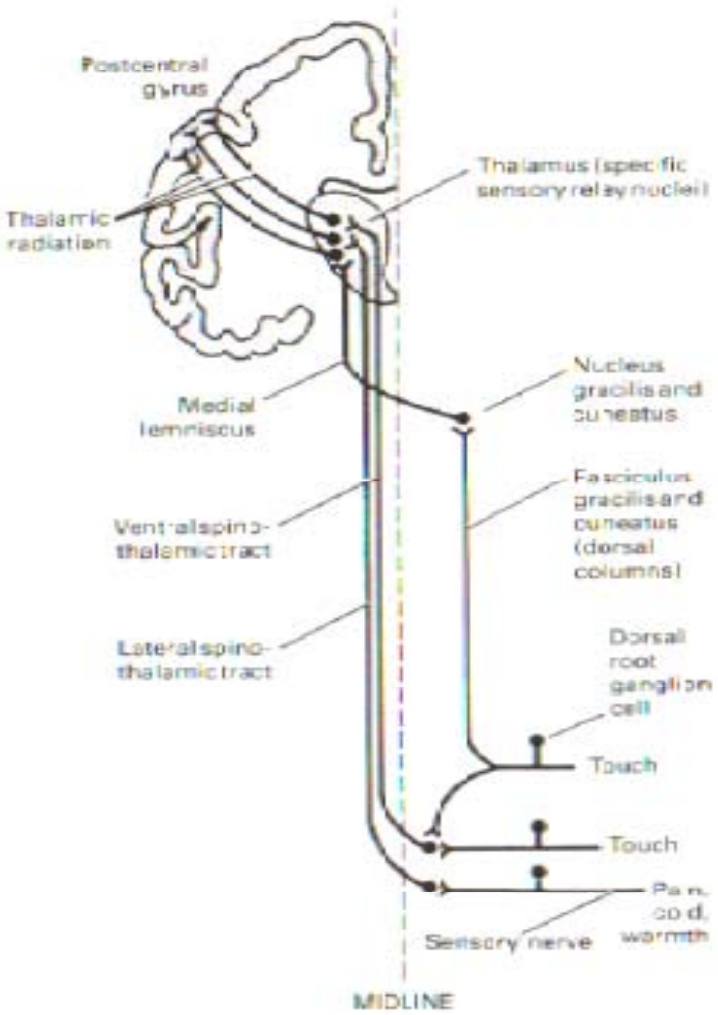
- International Association of the Study of Pain
  - “Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage”
- Chronic Pain [IASP]
  - “Pain without apparent biological value that has persisted beyond normal tissue healing time
  - 3 months [cancer pain]
  - 6 months [non-tumour related]”
- Chronic pain of moderate to severe intensity
  - Exists in 19-37% of the population
- Should be regarded as a syndrome or disease state [2]
  - May be a symptom of underlying disease which may require surgical intervention
  - Unique challenge characterised by; depression, anxiety, lack of energy & appetite

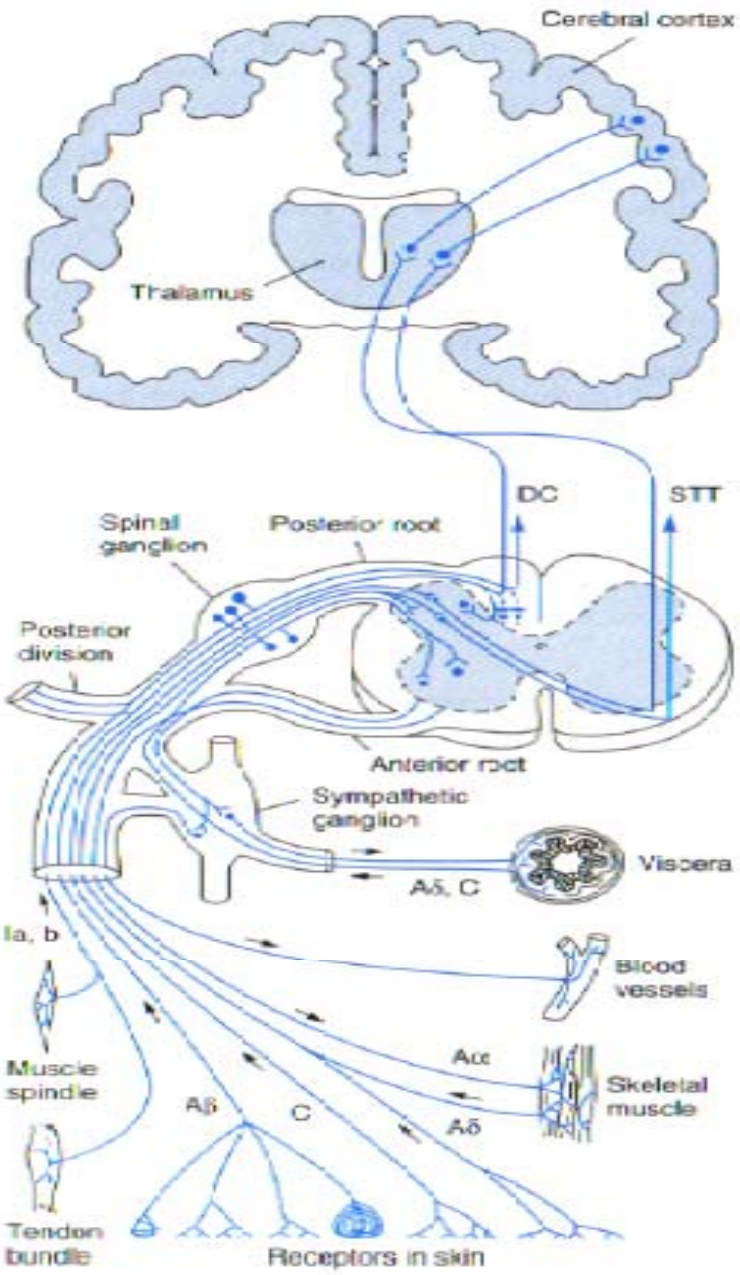
Primary and Secondary Hyperalgesia



- Normal pain response to injury
- Local increase in sensitivity to all stimuli as pain (touch = pain)
- Wider area of heightened sensitivity to all sensory modalities
- Mediated in Dorsal Root Ganglion and Dorsal Horn Grey Matter
- Prolonged pain can enforce the “wind up”
- Hyperalgesia requires stronger opiates and higher doses
- Can leading to persistent/chronic pain

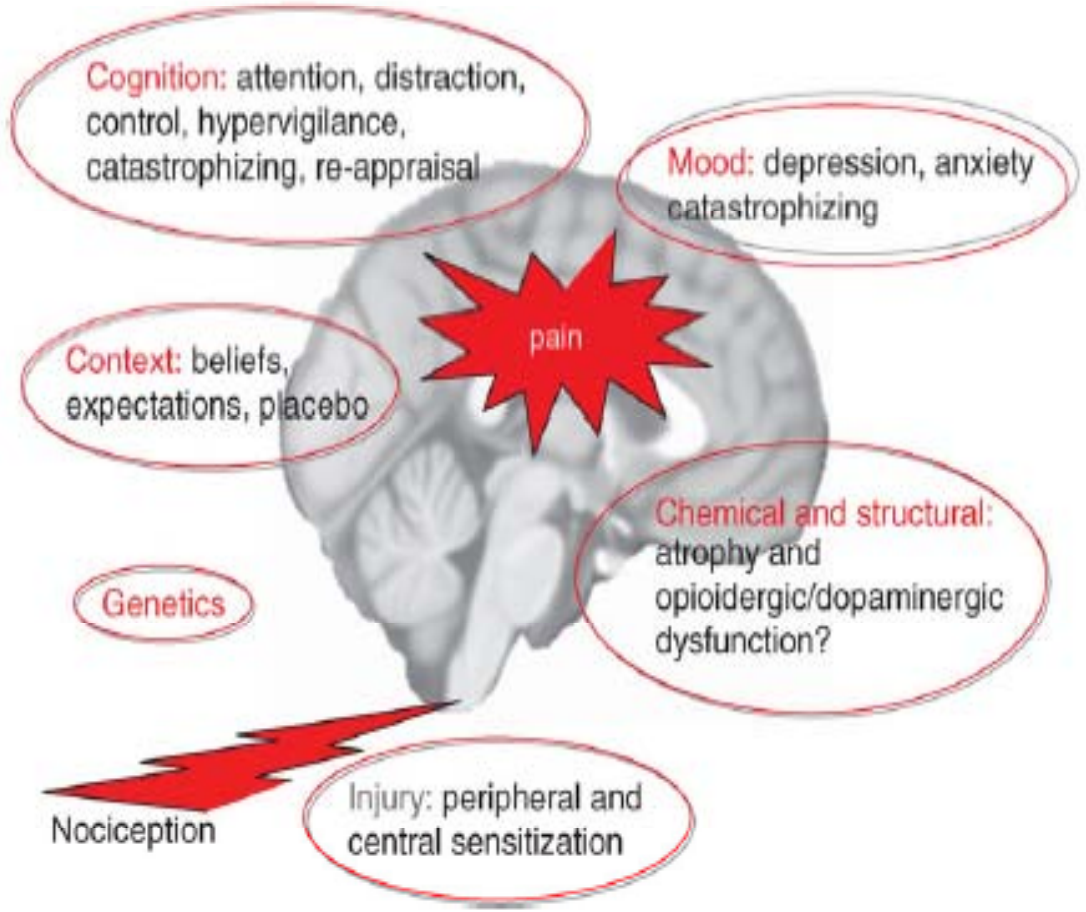
Pain Pathways



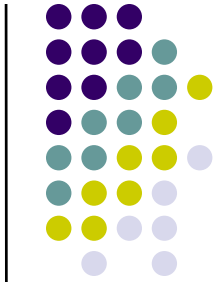


Pain perception

- Extensive, neural network is recruited
- Highly modifiable depending on
  - Genetics
  - Environment
  - Mood
  - Particular injury sustained
- Individualised pain experience
  - Unique cerebral signature



Pain perception



- Complex, multi-factorial subjective experience
- The ‘pain matrix’ accessed during nociceptive processing
  - Large distributed brain network
  - Lateralised sensory-discriminating areas
    - Somato-sensory cortex, Thalamus & Insula
  - Medial affective-cognitive-evaluative areas
    - Anterior cingulate cortex [ACC] & Prefrontal Cortex [PFC]
  - ‘pain matrix’ not a defined entity…
  - Depends on interplay between mood & cognition resulting in perception

Cerebral signature of pain

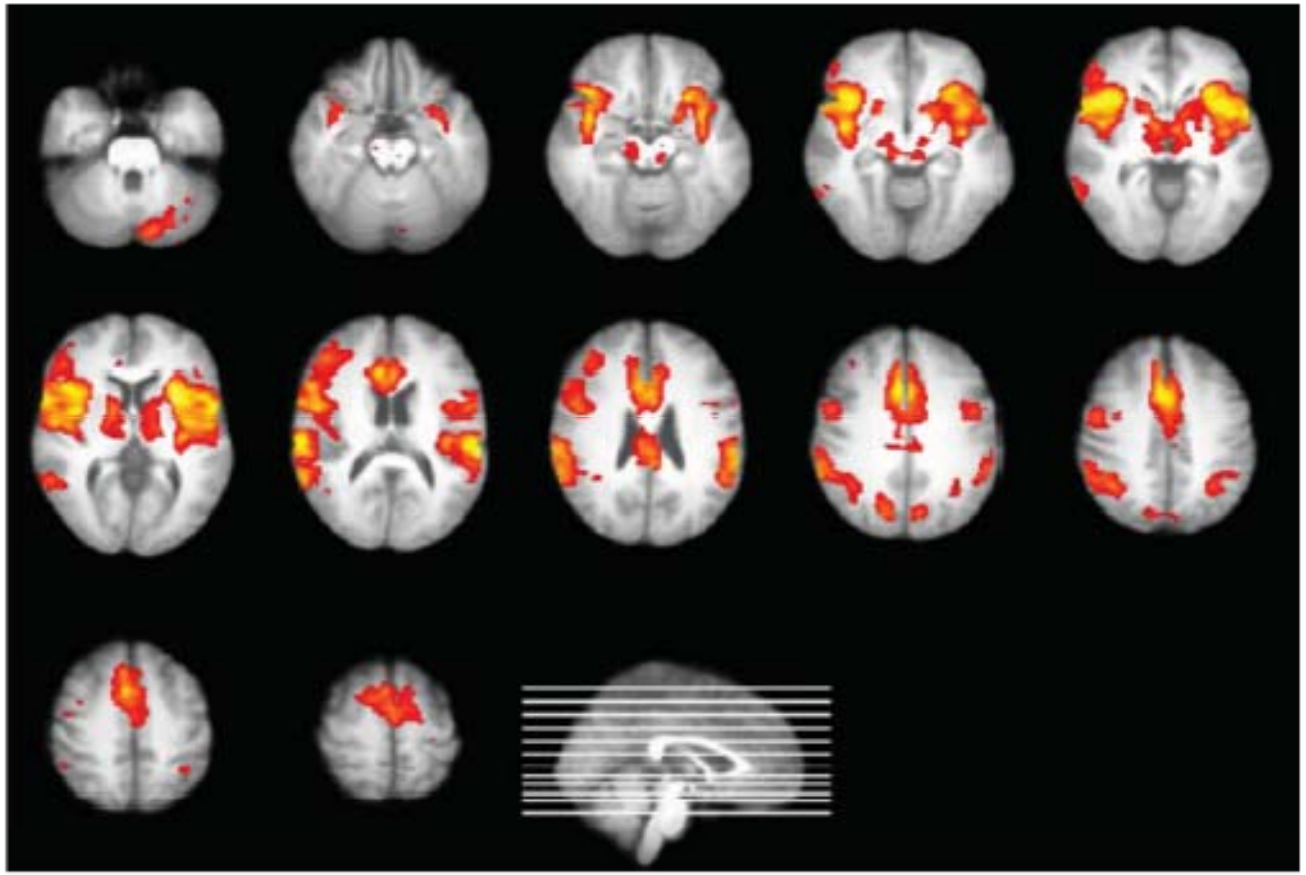
BJA 2008 101;1:32-39

Main regions activated in response to acute nociceptive stimulation (see diagram on right):

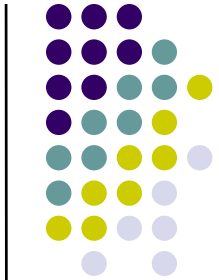
- Spinal cord
- Thalamus
- S1 and S2
- Insula (not always same division)
- Anterior cingulate cortex (not always same division)
- Prefrontal cortex

BUT THEN ALSO perhaps:

- Amygdala
- Hippocampus
- Posterior parietal cortex
- Basal ganglia
- Brainstem



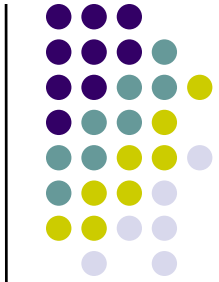
Risk factors for CPSP



- Minimally invasive surgical techniques
  - Laparoscopic [hand assisted] procedures
- Preventive analgesic strategies
  - weak evidence for effect on CPSP
  - **Early pain intensity higher in CPSP**
- Psychological, psychosocial & socio-demographic factors
  - Anxiety & depression scores higher in CPSP
  - Significantly disabled by other co-morbidities
  - Pain-related disability higher in CPSP
  - Habitual well-being & psychosomatic dysfunction scores deteriorate in CPSP

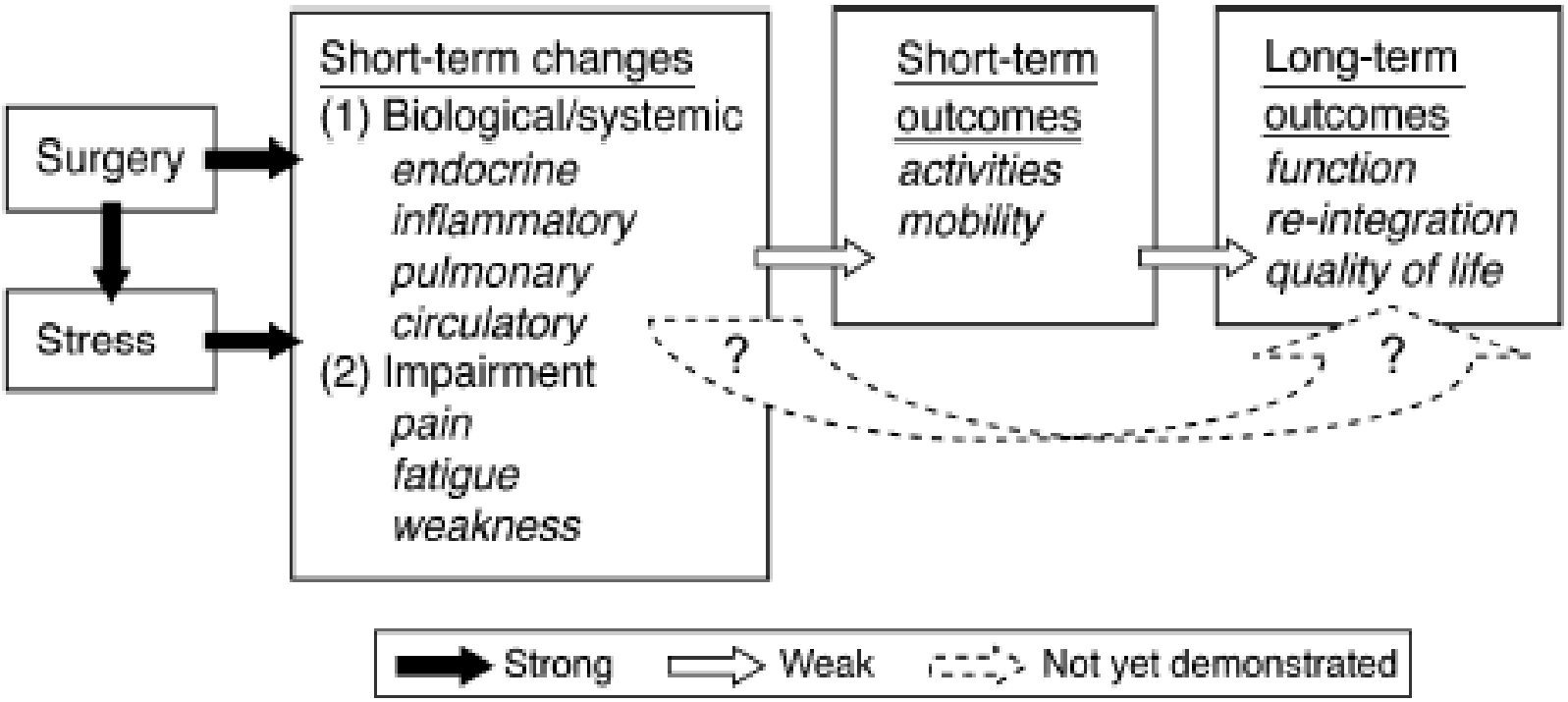
Predictive indicators for CPSP

EJP [epub] 2009

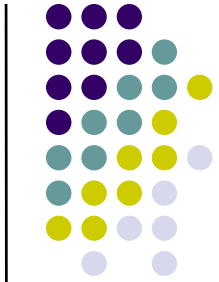


- Pre-operative anxiety scores higher
  - but NOT clinical depression
- Co-morbidity and related disability scores higher
  - Specific co-morbidities not studied
- Severity of acute post-surgical pain predictive
  - Associated with increased CPSP incidence
- Nerve lesions caused by surgical technique
  - Responsible for neuropathic pain syndromes
- Poor health related quality of life & Psycho-somatic dysfunction increased in CPSP
  - But only reflective of biopsychosocial consequences of chronic pain

A model for measuring outcome of anaesthetic and surgical procedures

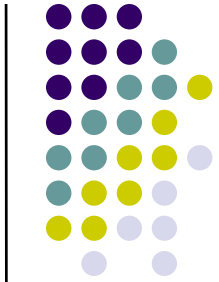


Overview of current situation



- Incidence of chronic post surgical pain 4% - 27%
- Number of patients treated with chronic opiates increased steadily over past decades
  - 83% of Australian pain centre referrals; opiates prescribed by GP for chronic benign & cancer pain [3]
  - 47% strong opiates; Morphine, Oxycodone, Methadone
  - 130% increase in USA sales of opiates to ambulatory patients 1999-2003 [double the previous decade] [4]
- No longer confined to terminal cancer patients or chronic pain patients
  - Long term opioid use and dose escalation seen in 33% of chronic non-cancer pain [5]

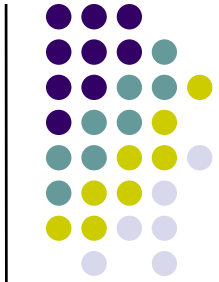
Comprehensive pain management strategy



- Identification and intervention of high risk patients
  - Optimisation of co-morbidities and pain control pre-op
  - Appropriate patient information & reassurance
  - Identify tolerance & withdrawal in the opiate dependant

- Pre-operative assessment issues
  - Complex medication regimes with significant interactions with anaesthetic drugs

Per- & post-op anaesthetic choices

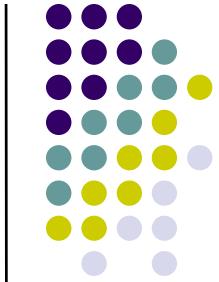


- Compared to GA, peri-neural anesthesia provides
  - Better postoperative analgesia
  - Less PONV

- Compared to opioids, peri-neural analgesia provides
  - Better postoperative analgesia
  - Less opioid related side-effects
  - Improved patient sleeping patterns
  - Higher patient satisfaction
  - Less admissions
  - Shortened hospital stays
  - Improved rehabilitation

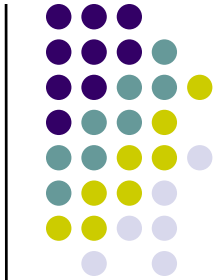
Current opinion…

Editorial CJA 2008 55-4:201-207



- Rapidly expanding patient population of complex, “minimally invasive”, ambulatory surgery
- Conventional opiate based and neuraxial strategies not practical
- Requires aggressive peri-operative analgesic regimen that is effective, minimal side effects and intrinsically safe
- Self management by patients and family away from the hospital.
- Definition of “multi-modal” inconsistent (+/- regional) and not continued into post-discharge period
- Important recovery variables;
  - resumption of normal activity; dietary intake, bowel function
  - return to work

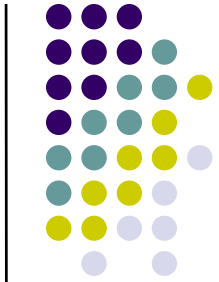
Pre-operative strategies



- Pre-emptive medication
  - Tylenol & NSAIDs
  - Cox II specific / Celebrex
  - Anti-epileptics / Gabapentin / Lyrica
  - NMDA antagonists / Ketamine / Dextromethorphan
  - Regional anaesthesia
- Fast track Clinical pathways
  - Bypass PACU
  - Early mobilisation
  - Early feeding
  - Fluid balance
- Appropriate patient information and consent process to accompany protocols

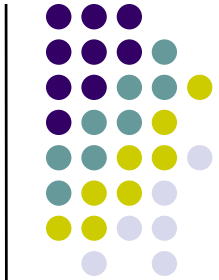
Patient information

www.youranaesthetic.info



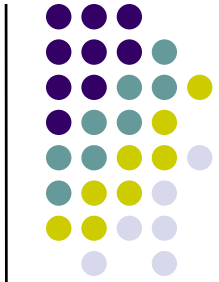
- Introduction
- *Commonly-asked Questions:*
- *What is the procedure?*
- *What happens when the procedure is being done?*
- *What are the advantages of the procedure?*
- *What are the side effects of the procedure?*
  - *Very Common & Common Side Effects: [about 1 in 10-100]*
  - *Uncommon Side Effects: [about 1 in 1000]*
  - *Rare & very rare risks: [about 1 in 10-100,000]*
- *The anaesthetic procedure is one of several options for [pain] management available to you. Please discuss the best option for you with your anaesthesiologist.*

Opioid tolerance



- Predictable pharmacological adaptation;
  - Rightward shift in dose response curve
    - Increasing amounts of opioid required to maintain same pharmacologic effect
- Neuro-adaptive changes; Receptor desensitization
  - Receptor down regulation, internalisation & decoupling of second messenger system
  - Up-regulation of cAMP; decreased inhibition of adenylate cyclase
  - Central glutaminergic system; NMDA receptor activation
- Tolerance
  - Develops to analgesic, sedative, euphoric, respiratory depression & nauseating effects but NOT constipation
  - Degree of tolerance related to duration of exposure, dose & receptor affinity
  - Asymmetric cross tolerance depending on this intrinsic efficacy
  - More potent less tolerance than less potent
    - E.g. [sufentanil < fentanyl < morphine]

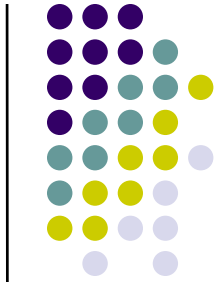
Opioid dependancy



- When confronted the anaesthetist needs to be able to anticipate, diagnose & treat
  - Breakthrough pain
  - Tolerance & Withdrawal
  - Overdose
  - Dependence

- Most important step is to identify these patients requiring chronic opiates
  - Self reporting and focussed history remains the best means of assessing opioid exposure
  - However they tend to under report their opiate usage
  - Failure to maintain opiate dosage up to and throughout peri-operative course, will precipitate withdrawal and uncontrolled pain

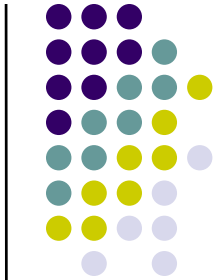
Pre-operative screening



- Detailed evaluation
  - Identify risk factors, make anaesthetics choices,
  - Plan peri-op analgesia management
  - Discuss with and educate the patient
- Optimise pain control pre-operatively
- Maintain baseline opioids up to and including the morning of surgery
  - Otherwise, an equivalent loading dose of opioid administered as oral elixir or intravenously during procedure

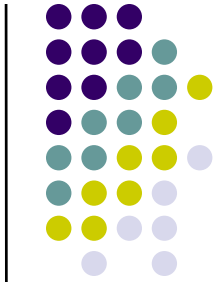
Drug	Oral dose	Parenteral dose
Morphine	15	5
Hydromorphone	4	1
Fentanyl	–	0.1
Methadone (acute)	0.8	1
Oxycodone	10	–
Meperidine	150	50

Systemic opioid rotation



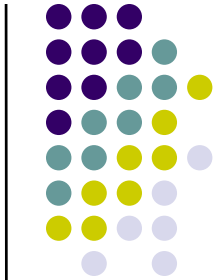
- Oral to intravenous
  - Dose reduction by factor of bio-availability [~50%]
  - Morphine < Methadone & Oxycontin
- Rotation to a new opiate when dose escalation seen
  - 25-30% dose reduction when converting to new opiate
- Controlled & immediate release formulation
  - Total opioid consumption divided
  - CR 50-60%
  - IR 40-50%

Summary of Pre-operative strategies



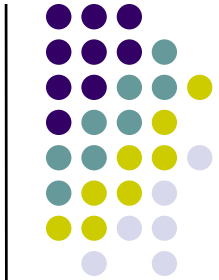
- Evaluation
  - Early recognition and high index of suspicion
- Identification
  - Total opioid dose requirement
  - Previous surgery/trauma
  - Under medication, inadequate analgesia or relapsing episodes
- Consultation
  - Peri-operative planning involving addiction & pain specialists if necessary
- Reassurance
  - Discuss & inform patient of concerns relating to pain control, anxiety and risk of relapse
- Medication
  - Calculate dose requirements and modes of administration

Estimation of opiate requirements



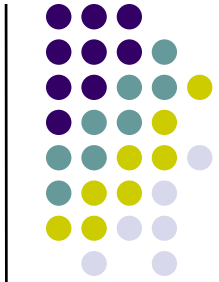
- Pre-operative
  - “Fentanyl challenge test” [6]
    - Estimate post-operative analgesic requirement
    - Fentanyl infusion @ 2mcg/kg/min given until respiratory depression [<5 breaths/min]
    - 30% of total accumulated Fentanyl dose
- Per-operative
  - Spontaneous ventilation as an end point of opiate loading under anaesthesia [7]
    - Simple and reliable endpoint to gauge individual response to systemic opiate [>12-14 breaths/min]
- Rehabilitation and detoxification
  - Should NOT be considered in immediate pre-op period
    - Can be considered following removal of the “pain generator” pathology but NOT in the immediate post-operative period

Per-operative



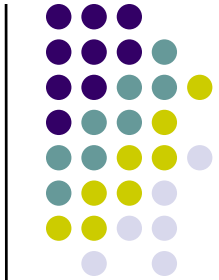
- Regional anaesthesia
  - Clinical judgement and expert opinion [2] in the absence of formal data, recommend the use of regional anaesthesia and analgesia whenever possible
  - Minimise pain perception and provide a substitute for opiates.
- Neuraxial [intrathecal] opiates
  - Efficacious at much reduced doses
  - Dose limitation reduces systemic side effects
  - However may evoke neuraxial side effects [retention, pruritis]
- [Epidural] low dose opiate with local anaesthetic
  - Standard of care
  - Local anaesthetic effect augments opiate
  - Variable down regulation of spinal opiate receptors
- Peripheral nerve blocks
  - Localised to site of surgery
  - Chronic opiates at baseline given in addition to breakthrough

Summary of Per-operative strategies



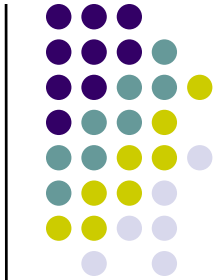
- Maintain baseline opioids
  - Dose, drug and route conversion calculations
- Intra- & post- operative opioid doses to compensate for tolerance
  - Hyperalgesia secondary to chronic opiates
  - Side effect profile unpredictable
- Provide neuraxial or peripheral regional anaesthesia when clinically indicated
  - As opiate replacement or reduction strategy
- Maximise non-opioid analgesic adjunct drugs
  - Opiate reduction and synergistic actions well recognised [8]

Non-opioid adjunctive medications



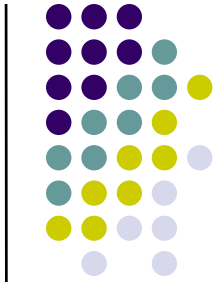
- Simple analgesia
  - Regular tylenol
- NSAIDs
  - Cox-I & Cox-II inhibitors
- Glucocorticoids
  - Dexamethasone 4-8mg
- Ketamine [NMDA antagonist]
  - 0.1mg/kg
- Clonidine & Dexmedetomidine [α_2-agonists]
  - Pre-medication and limitation of withdrawal symptoms
- Anti-convulsant drugs
  - Gabapentin & pregabalin

Multi-modal co-analgesia evidence base [8] [9] [10]



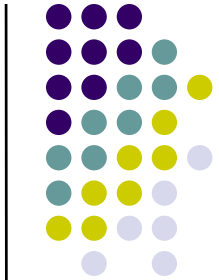
- Acetaminophen [meta-analyses]
  - Opioid sparing but no side effect reduction
- NSAID/Cox II [meta-analyses]
  - Enhanced analgesia, dose & side effect reduction
- Local anaesthetic [multiple meta-analyses]
  - Opioid dose & side effect reduction
- Anti-epileptic drugs [growing literature; clear cut evidence]
  - Opioid sparing but no side effect reduction
- NMDA antagonists [sufficient evidence]
  - **Ketamine**; opioid sparing with few side effects **0.15mg/kg**
  - (evidence weaker for dextromethorphan)
- *α_2-agonists* *[limited evidence]*
  - *Potential for opioid sparing but no side effect reduction*
- *β-blockers* *[limited evidence]*
  - *Opioid sparing*
  - *Reduction of cardiac events well recognized*
- *Glucocorticoids* *[positive although limited data]*
  - *Opioid dose reduction & decreased PONV*

Post-operative



- Continue regional technique as long as possible
  - Epidural catheter asepsis and monitoring
  - Ambulatory peripheral nerve block catheters
- Patient controlled intravenous analgesia
  - Accepted in opiate dependant patients
  - But ensure baseline opiates maintained
- Non-opioid adjuncts
  - Regular simple analgesia
  - Maximise anti-neuropathic adjuncts
- Side effect management
  - Multi-modal anti-emesis
  - Stool softeners & motility agents

Conclusion

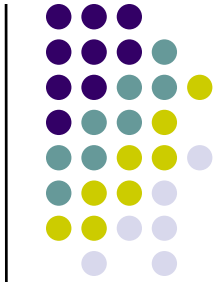


- Anaesthetist plays pivotal role in pre-operative assessment & implementation of a cognoscente intra- & post-operative plan, aggressively treating acute post-operative pain.
- Opioid dependant patients have special needs in the peri-operative period often requiring doses of opiates that would clearly result in overdose in opiate naïve patients to prevent under medication
- Severe pain in patients delivered to the PACU often results in an extremely difficult and time consuming management issue with the potential for severe physiological consequences resulting in CPSP
- CPSP incidence, prevalence and associations under appreciated due to lack of long term follow up, however social impact growing evident.
- Clinical awareness and appropriate administration of regional anaesthesia based multi-modal analgesic strategies with close clinical monitoring remains the key to successful peri-operative pain management

References

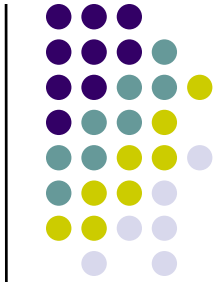
- [1] Swenson et al, Anest Clin N Am, 2005;23:37-49
  - Pharmacokinetic model for peri-op pain management in chronic opioid consumption
- [2] Stein et al, Best Pract Res Clin Anaesthesiol 2005;19:59-76
  - Reviews peri-op pain management in patients with chronic opioid dependancy
- [3] Nissen et al, Br J Clin Pharmacol 2001;59:693-698
  - Analgesic prescribing in the community and referral to tertiary centres
- [4] Davidson et al, Curr Opion Anaesthesiol, 2006;19:325-331
  - Peri-op pain management in chronic pain patient
- [5] Sinatra et al, Anaestheiol, 2004;101:212-227
  - Peri-op pain management in opioid dependant patient
- [6] Davis et al, Anesth Analg 2005;101:389-395
  - Proposes pharmacokinetic model to optimise intra- & post-op opioid dosing
- [7] Grass et al, Pain Pract 2005;5:18-32
  - Clinical aspects of opioid use and tolerance
- [8] White, Anesth Analg 2005;101:S5-S22
  - Reviews non-opioid analgesics and their role in peri-op analgesia
- [9] Kehlet, Curr Con Clin Surg 2004;389:244-249
  - Post-op pain management strategies and outcome review
- [10] Anesth Analg 2007;104-6:1380-96
  - Review of evidence base for multi-modal co-analgesics

Case 1



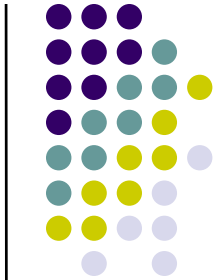
- 78 yr old male, IDDM, HTN, CABG, chronic vascular ulcers
- Booked for aorto-bifem revascularisation
- Chronic opiates;
  - Fentanyl patch 75mcg/3days
  - Tramacet but poorly effective
  - No side effects
- NKDA
- Heparin infusion
- Leg Pain “drilling” with “sudden shocks”

Case 1



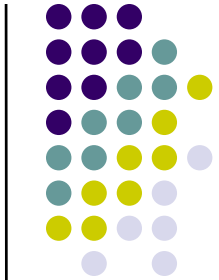
- Pre-op
  - Cardiac investigations
  - Coagulation screen & blood products
  - Continue fentanyl patch at increased dose?
  - Stop tramacet?
  - Rotate to new opiate?
  - Insert epidural pre-op?
  - Add pharmacotherapy?
    - Anti-neuropathics
    - *α_2-agonists*
- Per-op
  - GA with epidural?
  - Opiate based GA?
- Post-op
  - Continue epidural
  - Opiate PCA?

Case 2



- 17 yr old GSW trauma
- Right ulnar arterial & nerve injury with multiple fractures requiring fasciotomy
- Right chest Pneumothorax and rib fractures with chest drain
- Pain with respiration with lung contusions and atelectasis
- Requires thoracotomy and segmentectomy
- Burning & pins and needles right arm
- Tylenol RTC
- Fentanyl infusion [75mcg/hr] on ICU
- NKDA
- No other antecedents

Case 2



- Pre-op
  - Maximise pain control with opiate infusion?
  - Add pharmacotherapy?
  - Add NSAID?
  - Pre-op epidural?
- Per-op thoracotomy
  - Opiate based GA & continue fentanyl infusion post-op?
  - Rotate to oral opiates and iv PCA after extubation?
  - GA with Epidural for thoracotomy?
- Post-op
  - Rotate to oral opiates?
  - Add anti-neuropathic?
  - Regional anaesthesia for nerve injury pain?

[Anesth Analg 2007;104-6:1380-96]

The Role of the Anesthesiologist in Fast-Track Surgery: From Multimodal Analgesia to Perioperative Medical Care

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BACKGROUND: Improving perioperative efficiency and throughput has become increasingly important in the modern practice of anesthesiology. Fast-track surgery represents a multidisciplinary approach to improving perioperative efficiency by facilitating recovery after both minor (i.e., outpatient) and major (inpatient) surgery procedures. In this article we focus on the expanding role of the anesthesiologist in fast-track surgery.

METHODS: A multidisciplinary group of clinical investigators met at McGill University in the Fall of 2005 to discuss current anesthetic and surgical practices directed at improving the postoperative recovery process. A subgroup of the attendees at this conference was assigned the task of reviewing the peer-reviewed literature on this topic as it related to the role of the anesthesiologist as a perioper
physician.

RESULTS: Anesthesiologists as perioperative physicians play a key role in fast-
surgery through their choice of preoperative medication, anesthetics and

Table 2. Key Elements of the Perioperative Anesthetic Management for Facilitating a Fast-Track Recovery After Elective Surgery

I. *Preoperative period*
- Stabilizing coexisting diseases (e.g., hypertension, diabetes) and encourage prehabilitation exercise program and smoking cessation
- Optimizing patient comfort by minimizing anxiety and discomfort
- Insure adequate rehydration by replacing fluid deficits
- Appropriate use of prophylactic therapies to prevent postoperative complications (e.g., nausea, vomiting, pain, ileus)

II. *Intraoperative period*
- Utilize anesthetic techniques which optimize surgical conditions, while insuring a rapid recovery with minimal side effects
- Administer local analgesia via peripheral nerve blocks, wound infiltration, and/or instillation
- Apply multimodal analgesia and antiemetic prophylaxis (including use of glucocorticoid steroids)
- Minimize use of nasogastric tubes and avoid excessive fluid administration

III. *Postoperative period*
- Allow patients who meet discharge criteria to be fast-tracked (i.e., discharged earlier from recovery units)
- Insure adequate pain control in the postdischarge period utilizing non-opioid analgesics to minimize need for opioid-containing analgesics
- Encourage early ambulation and resumption of normal activities of daily living

Table 3. Future Strategies for Anesthesiologist to Advance Fast-Track Surgery

1. Participate in identification of preoperative risk factors and improvement in organ function by optimizing intra- and postoperative hemodynamic stability (268)
2. Development of multimodal non-opioid analgesic and antiemetic regimens based on the type of surgery and the patient's risk assessment (66,140,141)
3. Pharmacological modifications of the autonomic "stress" responses during and after surgery (269)
4. Optimizing perioperative fluid regimens based on the duration of preoperative fasting and the type of surgery (e.g., intracavitary, blood loss) (30,31)
5. Postoperative rounds by anesthesiologists caring for high-risk surgical patients (270)
6. Establishment of "outreach" services for ancillary healthcare personnel involved in facilitating the rehabilitation process (271)
7. Multidisciplinary approaches to routine perioperative care which would ideally include specific procedure-based clinical pathways (162,272)
8. Preventing acute postoperative pain from becoming a chronic problem by optimizing the analgesic therapy both before and after discharge from the surgical facility (65)

Cardiac Morbidity & Mortality

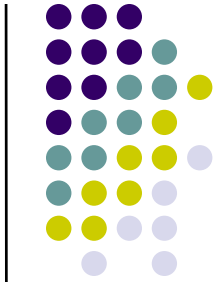


Table 1. Included Articles that Examined Effects of Epidural Analgesia on Postoperative Mortality and Morbidity

Study (References)	N	Surgical procedure	Mortality (%)		Cardiovascular complication (%)	
			Epidural	Control	Epidural	Control
Meta-analyses						
Rogers 2000 (6)	9559[a]	Mixed	1.9*	2.8	na	na
Nishimori 2006 (7)	1224	Open aortic	3.5	4.3	0.75* RR	
Liu 2004 (1)	1178	CABG	0.7	0.3	na	na
Beattie 2001 (8)	1173	Mixed	3.1	4.4	na	na
Ballantyne 1998 (9)	1016	Mixed	na	na	na	na
Werawatgannon 2005 (10)	711	Abdominal	na	na	na	na
Choi 2003 (11)	555	THR TKR	na	na	na	na
RCT						
Park 2001 (12)	984	Mixed	4	3	8.6	11.2
	374	Aortic subgroup	na	na	9.8*	17.9
Rigg 2002 (13)	915	Mixed abdominal	5.1	4.3	2.6	2.4
Medicare data						
Wu 2004 (2)	68,723	Mixed	2*	2.5	na	na
Wu 2003 (14)	23,136	THR	0.6	1	na	na

RR = relative risk, and incidences were not reported; CABG = coronary artery bypass graft; THR = total hip replacement; TKR = total knee replacement; na = not available.

[a] Epidural group also included spinal and epidural anesthesia, and 4498 patients received epidural analgesia.

* Statistically significant.

Liu SS, Wu CL. Anesth Analg 2007; 104: 689-702

Respiratory Morbidity & Mortality

Table 1. (continued)

Myocardial infarction (%)		Pulmonary complication (%)		Respiratory Failure (%)		Pneumonia (%)	
Epidural	Control	Epidural	Control	Epidural	Control	Epidural	Control
0.9	1.3	na	na	na	na	3.1*	6
0.52 RR*				0.63* RR		0.64 RR	
2.3	3.4	17.2*	30.3	na	na	na	na
2.8*	5.3	na	na	na	na	na	na
na	na	0.58* RR	na	na	na	0.38* RR	na
na	na	na	na	na	na	na	na
na	na	na	na	na	na	na	na
3.5	5.3	na	na	9.9	14	7.9	5.4
2.7	8	na	na	14*	28	na	na
na	na	na	na	23*	30	na	na
0.03	0.03	na	na	0	0	0.02	0.02
0.8	0.8	na	na	na	na	1.3	1.5

Liu SS, Wu CL. Anesth Analg 2007; 104: 689-702

Gastro-Intestinal and Thrombo-embolic Outcomes

Table 2. Included Articles that Examined Effects of Epidural Analgesia on Postoperative Morbidity

Study (Reference)	N	Surgical procedure	Ileus (%)		DVT (%)		Pulmonary embolism (%)	
			Epidural	Control	Epidural	Control	Epidural	Control
Meta-analyses								
Rogers 2000 (6)	9559*	Mixed	na	na	2.9*	4.7	0.6*	1.4
Choi 2003 (11)	555	THR TKR	na	na	na	na	na	na
Jorgensen 2003 (35)	1023	Abdominal	−37 to −24 h with epidural local anesthetic[a]		na	na	na	na
RCT				na				
Medicare								
Wu 2004 (2)	68,723	Mixed	0	0.007	0.02	0.01	0.04	0.03
Wu 2003 (14)	23,136	THR	0.7	1	0.97*	0.61	0.5	0.6

THR = total hip replacement; TKR = total knee replacement; DVT = deep venous thrombosis; NA = not available.

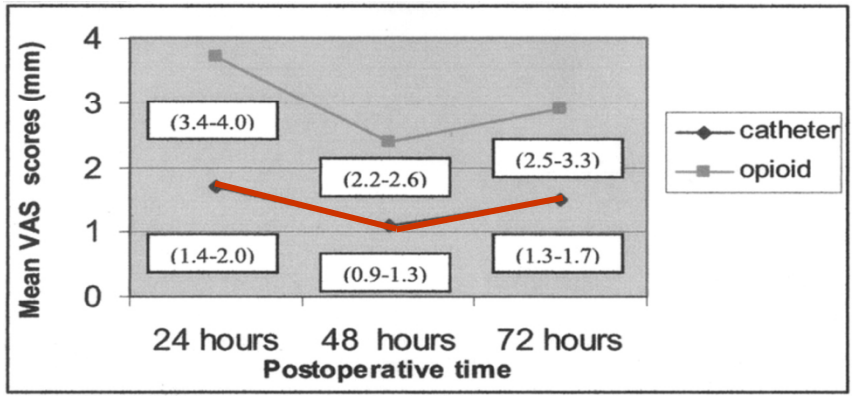
[a] Weighted mean difference with 95% CI.

* Statistically significant.

Liu SS, Wu CL. Anesth Analg 2007; 104: 689-702

Opioids vs Peripheral nerve block

Anesth Analg 2006;102:248-57



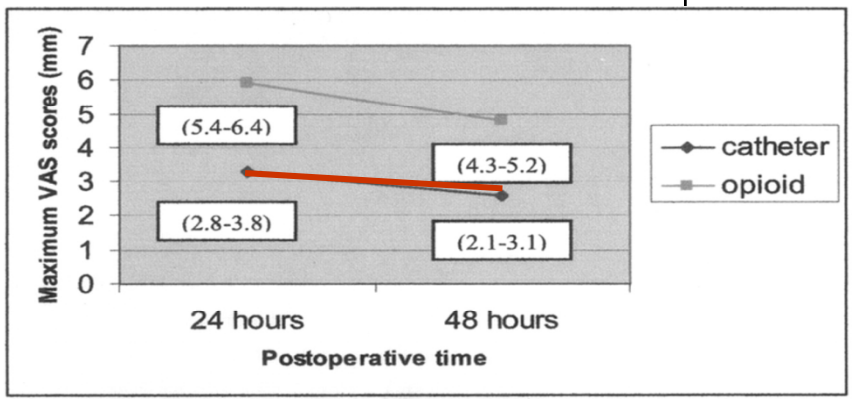


Table 6. Side Effects

Side effects	Catheter	Opioid	*P* value	Odds ratio	NNT
Nausea/vomiting	38/182 (20.9%)	95/195 (48.7%)	<0.001	0.28	4
Sedation	12/45 (26.7%)	23/44 (52.3%)	<0.012	0.33	4
Pruritus	11/113 (9.7%)	29/109 (26.6%)	<0.001	0.30	6
Sensory/motor block	22/70 (31.4%)	9/60 (15.0%)	<0.023	0.39	

In results, numerator represents total number of patients noted to have side effect. Denominator represents total number of patients in group from studies that listed complications in the given category. Results weighted by subject number; e.g. 38/182 indicates that studies documenting nausea and vomiting as a side effect had 182 patients randomized to the catheter group and reported 38 of those patients having either nausea or vomiting. Number in parenthesis represents percentage of patients reported to have side effects. NNT = number needed to treat. NNT was not calculated for motor block since it is not a treatable event.

RA vs GA for Ambulatory surgery

Liu SS et al Anesth Analg 2005;101:1634-42

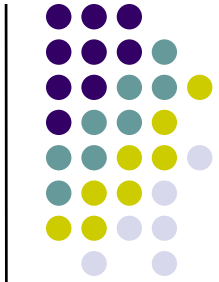


Table 4. Effects of Peripheral Nerve Block Versus General Anesthesia on Ambulatory Surgical Patients

Outcome	n	Number of trials	Peripheral nerve block* (mean)	General anesthesia* (mean)	OR or WMD** (95% confidence interval)	*P* value
Anesthesia induction time (min)	329	6	19.6	8.8	8.1 (2.6 to 13.7)	0.0001
PACU time (min)	308	6	45.2	72	−24.3 (−36.3 to −12)	0.0001
VAS in PACU (mm)	359	7	9.6	35.8	−24.5 (−35.7 to −13.3)	0.0001
Nausea	319	6	6.8%	30%	0.17 (0.08 to 0.33)	0.0001
Phase 1 bypass	329	6	81%	315	14.3 (7.5 to 27.4)	0.0001
Need for postoperative analgesics	259	6	6.2%	42.3%	0.11 (0.03 to 0.43)	0.001
Time until discharge from ASU (min)	328	6	133.3	159.1	−29.7 (−75.3 to 15.8)	0.2
Excellent patient satisfaction	158	4	88%	72%	4.7 (1.8 to 12)	0.001

OR = odds ratio; WMD = weighted mean difference; * weighted by subject number; ** weighted by inverse variance; PACU = Postanesthesia care unit; ASU = ambulatory surgical unit; POD = postoperative day; VAS = visual analogue scale.
7 randomized controlled trials with 359 patients were included for meta-analysis.

- Excellent post-op analgesia
- Reduced PONV
- No decrease in time to discharge
  - Neuraxial anaesthesia increased PACU time despite less pain & side effects ? Block duration ?
  - Peripheral regional anaesthesia decreased PACU time but overall surgical unit time unchanged
  - Discharge criteria and practice changes required to maximize potential benefits