Medicine®

Quality Improvement Study

OPEN

An Audit of Changes in Outcomes of Acute Pain Service

Evolution Over the Last 2 Decades

Sheng Jia Low, MBBS, FANZCA, Stanley Sau Ching Wong, MBBS, FHKCA, FHKAM, FANZCA, Qiu Qiu, MD, Yvonne Lee, MPHC, Timmy Chi Wing Chan, MBBS, FHKCA, FHKAM, FANZCA, Dip Pain Mgt, Michael G. Irwin, MB, ChB, MD, FRCA, FCAI, FANZCA, FHKAM, and Chi Wai Cheung, MBBS, MD, FHKCA, FHKAM, Dip Pain Mgt

Abstract: Acute pain services (APS) have evolved over time. Strategies nowadays emphasize multimodal analgesic regimes using a combination of nonopioid adjuvant analgesic drugs, peripheral nerve blocks, and local anaesthetic wound infiltration where appropriate. APS should be assessed over time to evaluate changes in outcomes which form the basis for future development.

In this audit, data of patients under APS care in Queen Mary hospital, Hong Kong, between 2009 and 2012 were analyzed and compared with data from a previous audit between 1992 and 1995. The use of patient-controlled analgesia (PCA) was increased (from 69.3% to 86.5%, $P < 0.001$), while the use of epidural analgesia reduced (from 25.3% to 8.3%, $P < 0.001$) significantly. Although postoperative pain scores did not improve, PCA opioid consumption and the incidence of analgesia-related side effects were significantly less (all $P < 0.001$). More patients graded their postoperative analgesic techniques used as good when the results from these 2 audit periods were compared ($P < 0.001$ and $P = 0.001$ for PCA and epidural analgesia, respectively). In conclusion, there has been a change in analgesic management techniques, but there has been no improvement in overall pain relief. While changes over time have led to improvement in important parameters such as the incidence of side effects and patient satisfaction, further and continuous efforts and improvements are warrant to reduce acute pain relief and suffering of the patients after the surgery.

(*Medicine* 94(40):e1673)

Abbreviations: APS = acute pain services, ASA = American Society of Anesthesiologists physical status classification system, MASTER = The Multicenter Australian Study of Epidural Anesthesia and Analgesia in Major Surgery, NMDA = N-methyl-D-aspartate, NRS = numerical rating scale, NSAIDs = non-steroidal anti-inflammatory drugs, PCA = patient-controlled analgesia, PONV = postoperative nausea and vomiting, SPSS = Statistical Package for the Social Sciences.

Editor: Kazuo Hanaoka.
Received: August 7, 2015; revised: August 25, 2015; accepted: September 2, 2015.
From the Laboratory and Clinical Research Institute for Pain, Department of Anaesthesiology, The University of Hong Kong, Hong Kong (SJL,SSCW, QQ, YL, MGI, CWC); Department of Anaesthesiology, Queen Mary Hospital, Hong Kong (TCWC).
Correspondence: Chi Wai Cheung, Department of Anaesthesiology, The University of Hong Kong, Room 424, Block K, Queen Mary Hospital, 102 Pokfulam Road, Hong Kong (e-mail: cheucw@hku.hk).
This study was supported by the Department of Anaesthesiology, The University of Hong Kong.
The authors have no funding and conflicts of interest to disclose.

ISSN: 0025-7974
DOI: 10.1097/MD.0000000000001673

INTRODUCTION

Over 80% of patients undergoing surgery experience postoperative pain and in 39% this is severe to extreme.[1] It is well recognized that patients should be able to access best practice care including appropriate assessment of their pain and effective pain management strategies.[2] Suboptimal acute pain management results in various undesirable effects such as increased risk of myocardial ischaemia or infarction, thromboembolic and pulmonary complications, persistent postoperative pain, prolonged hospital stay, increased hospital admission, reduced quality of life, and side effects due to analgesic consumption.[3–7] The first acute pain service (APS) run by anaesthesiologists was introduced in 1988[8] and such teams have since become ubiquitous in modern healthcare.

A Hong Kong survey in 1996 identified a need for increased resources, training, awareness, and staffing in pain management[9] and Queen Mary Hospital organized a multidisciplinary APS team that involved anaesthetists, pain nurses, surgeons, and ward nurses. Eighty-six percent of the hospitals in Hong Kong that provided anaesthetic services were running an acute pain service by 2000.[10] Our acute pain management has expanded over the years to now include accredited pain specialists, full time pain nurses, and pain fellowship trainees.[11]

Advances in APS include increasing emphasis on the implementation of multimodal analgesia and toward procedure-specific management, where pain protocols are targeted to specific surgical operations.[12] Benefits in terms of postoperative pain, incidence of adverse effects due to analgesia, quality of life, and patient satisfaction were demonstrated with the implementation of quality management systems using procedure-specific and multimodal pain protocols adapted to individual patients.[13] Various strategies targeting the preoperative, intraoperative, and postoperative period have been employed as part of a multimodal analgesic regimen. Examples include the use of peripheral nerve blocks and infusions, as well as numerous adjuvant medications such as nonsteroidal antiinflammatory drugs (NSAIDs), paracetamol, ketamine, and anticonvulsants (such as pregabalin and gabapentin).[14]

In view of the increased demand for pain management services and the large number of patients utilizing the APS, regular audit is mandatory to ensure the delivery of quality care and demonstrate effectiveness of such treatments to facilitate future service planning.[15] The aim of this audit is to compare the APS in Queen Mary Hospital between the epochs 2009 to 2012 and 1992 to 1995.[16] More specific objectives were to identify the changing trends of pain management modalities; evaluate effectiveness in terms of pain relief, morphine consumption, and patient satisfaction; determine safety and tolerability by comparing incidence of various complications associated with pain management.

METHODS

This retrospective study was conducted in Queen Mary Hospital, a tertiary referral hospital in Hong Kong, and approved by the Institutional Review Board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster. This study was registered at ClinicalTrials.gov (registration number NCT02155413). Data were collected from the patient records kept by the APS team of the Department of Anesthesiology, Queen Mary Hospital, Hong Kong. Data from patients under APS care between 2009 and 2012 were collected, validated, and analyzed. These data were then compared with data from our previous audit of the period between 1992 and 1995. Patients were excluded from the analysis if they were ventilated after surgery or if essential data were missing. Chronic pain patients, opioid or sedative users or drug addicts, patients with language barrier with difficulty in pain assessment after operation, and patients involved in other ongoing research were also excluded.

All patients managed by the APS received one of the postoperative analgesic regimens outlined in Table 1. They were also managed according to a standard protocol. Monitoring included continuous pulse oximetry for 24 h postoperatively, hourly respiratory rate, and sedation score, 4 hourly blood pressure, pulse rate, pain scores using numerical rating scale (NRS), and analgesic related side effects including nausea and vomiting. During the preoperative visits, patients were given detailed information about postoperative analgesia and asked to report any side effects including nausea, vomiting, dizziness, pruritus, or lower limb weakness (for epidural infusion). In addition, nursing staff would also specifically ask about these side effects, while charting the pain scores at 4 hourly intervals. Patients were advised to report any other effects that they felt might be related to their treatment.

After the operation, patients were transferred to the recovery area where their vital signs including blood pressure, oxygen saturation, electrocardiogram, and NRS pain scores at rest and during cough were assessed. Pain management including boluses of intravenous morphine or local anaesthetic via the epidural route would be given by the attending anaesthetist until the NRS score was 3 or less before transfer to the ward. Rescue pain medications and antiemetic use were also documented.

Patients were reviewed daily. The NRS pain scores, cumulative opioid or local anaesthetic use, rescue analgesics, and complications were also documented. If patients had epidural analgesia, bromage scores, sensory levels were noted and insertion site inspected. When oral intake was permitted, oral analgesics including paracetamol, NSAIDs, gabapentinoids, and opioids were prescribed by the APS. Suitability for termination of APS review and pain management was reviewed during the visit. Patients were then asked to grade their satisfaction on pain management as "good," "fair," or "unsatisfactory" at discharge from the APS service.

The APS team or on-call anaesthetist was informed if a severe adverse event occurred. These included loss of consciousness (unrousable and a sedation score of 3 or less), bradypnoea (respiratory rate <10/min), hypotension (systolic BP < 90 mm Hg), hypercapnoea ($PaCO_2$ > 7 kPa), or oxygen desaturation (SpO_2 < 90%). Management of such adverse events would initially include cessation of analgesic technique and appropriate resuscitation. In the event of possible opioid-induced respiratory depression (bradypnoea, hypercapnoea, or oxygen desaturation) that failed to resolve with simple manoeuvres, naloxone 0.2 mg could be given intravenously until resumption of normal respiration with an oxygen saturation of >90%. Management of hypotension also included administration of intravenous fluids with intravenous ephedrine 5–10 mg every 5 min as required. Surgeons were also informed if surgical complications (e.g., haemorrhage) were suspected to be the cause.

Demographic data, postoperative pain scores, prevalence of complications and adverse events, and patient-rated satisfaction for postoperative analgesia were compared between time periods. Parametric values were tested by *t* test and are presented as mean ± SD. Nonparametric values were tested by the Mann–Whitney *U* test and presented as median [interquartile range (IQR)]. Categorical values were tested by χ^2 test or Fisher exact test as appropriate and presented as number (percentage). The significance level was set at 0.05. All analyses were performed using Statistical Package for the Social Sciences (SPSS) Statistics version 20 (SPSS Inc, Chicago, IL).

RESULTS

A total of 7659 records of postoperative APS patients were audited between 2009 and 2012. Of these, 1452 (18.8%) records were excluded from data analysis. The results of the 2009 to 2012 audit were compared with the data of a similar audit done

TABLE 1. Standard Regime for Postoperative Analgesia

Regime	Drugs	Loading Dose	Infusion (mL/h)	Demand Dose/ Lockout Interval	1 h Maximum
PCA	Morphine	1–1.5 mg every 10 min until patient is comfortable		1–1.5 mg bolus. 5–10 min lockout	4.5–7.5 mg
CEA	Levo Bupivacaine 0.1%; Fentanyl 2 mcg/mL	Levo; Bupivacaine; 0.25–0.5%; (4–8 mL) before skin incision	6–12 mL/h	Nil	nil
OR	Ropivacaine 0.15% Fentanyl 2 mcg/mL	Ropivacaine 0.375% (4–8 mL) before incision	6–12 mL/h	Nil	nil
CPNB (femoral catheter)	Ropivacaine 0.2%		5–10 mL/h	Nil	nil

CEA = continuous epidural analgesia; CPNB = continuous peripheral nerve block; PCA = patient-controlled analgesia.

TABLE 2. Patient Demographic

	2009–2012 (n = 6207)	1992–1995 (n = 2319)	*P* Value
Age (mean)	58.9	54.5	<0.001
Body weight (mean kg)	60.3	55.8	<0.001
ASA I	14.3	27.4	<0.001
ASA II	54.4	50.2	
ASA III	30.4	21.5	<0.001
Emergency surgery	13.7	5.1	<0.001

TABLE 3. Distribution of Analgesic Techniques Used

	2009–2012	1992–1995	*P* Value
PCA	5524 (86.5)	1606 (69.3)	<0.001
EPI	518 (8.3)	586 (25.3)	<0.001
PNB	164 (2.7)	0 (0.0)	N.A.
IM	I (0.02)	90 (3.9)	N.A.
IV	0 (0.0)	37 (1.6)	N.A.

Data in n (%). EPI = epidural; IM = intramuscular; IV = intravenous; PCA = patient-controlled analgesia; PNB = peripheral nerve block.

the same centre between 1992 and 1995. For the purpose of clarity in presentation these audits will henceforth be referred to as audit 1 (1992–1995) and audit 2 (2009–2012).

Patient Demographic and Surgery Types

Demographic data of audit 1 and audit 2 was shown at Table 2. While gynaecological surgeries (22.9%) were the most frequent surgery requiring APS in audit 1, limb surgeries were the most frequent in audit 2 (Figure 1). There was also a 7.2% increase in the number of patients aged over 65 years using APS ($P < 0.001$). More than 50% of the patients undergoing either colorectal, hepatobiliary, or limb surgeries were above 65 years. Mean body weight increased from 55.8 kg to 60.3 kg ($P < 0.001$) over the last 2 decades. The proportion of American Society of Anesthesiologists physical status classification system (ASA) II and III patients using APS also increased by 4.2% and 8.9%, respectively. The proportion of emergency surgery also increased significantly from 5.1% to 13.7%.

Postoperative Analgesic Techniques

Postoperative analgesic techniques used are described in Table 3. There was a significant increase in PCA use from 69.3% to 86.5% ($P < 0.001$). Epidural use decreased markedly from 25.3% to 8.3% ($P < 0.001$) and the majority of its use recently was in upper gastrointestinal surgery with an increase from 10.7% to 27.8% ($P < 0.001$). Peripheral nerve block use has been routinely documented since 2009, with 2.6% of operations from 2009 to 2012 applying it and majority of its use occurring in limb surgery. Intramuscular injections diminished significantly from 90% to 1% in the latest audit.

Duration of APS Use, Opioid Consumption, and NRS Pain Scores

Duration of postoperative PCA and epidural use has increased by 5.4 and 37 h, respectively (all $P < 0.001$, Table 4). Morphine consumption (for PCA use) in audit 2 decreased from a mean of 49.6 to 36.2 mg ($P < 0.001$). The mean NRS pain scores when coughing at day 2 to day 3 postoperatively with PCA use were higher ($P < 0.001$) in audit 2 than audit 1. For patients receiving epidural analgesia, patient-reported NRS pain scores at rest were higher on days 2 and 3 in audit 2 ($P < 0.025$ and $P < 0.001$ respectively, Table 5)

Common Side Effects and Serious Adverse Events

There was no bradypnoea or hypoxia, and hypotension decreased from 1.0% to 0.1% between audits 1 and 2 ($P < 0.001$, Table 6). There was a significantly lower incidence of hypotension and lower limb weakness following epidural use (all $P < 0.001$).

The incidence of all adverse events following PCA use decreased recently. There was a statistically significant

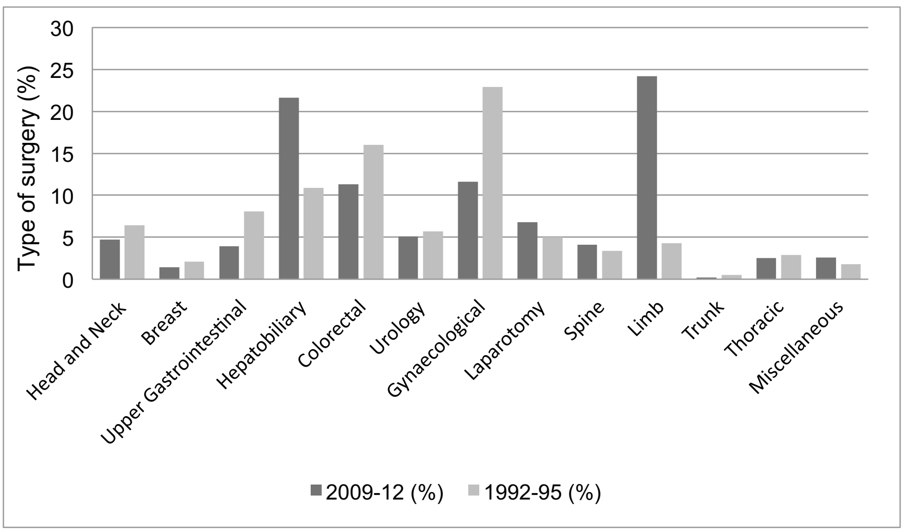

FIGURE 1. Different types of operation performed in 1992–1995 and 2009–2012.

TABLE 4. Duration of Different Postoperative Analgesic Techniques and the Number of Patients on Different Postoperative Analgesia in the First 3 Days

	2009–2012	1992–1995	P Value
PCA			
Duration (h) Mean	51.7	46.3	<0.001
Day 1 n (%)	5524 (100.0)	1606 (100.0)	
Day 2 n (%)	4299 (77.8)	1310 (81.6)	
Day 3 n (%)	2237 (40.5)	451 (28.1)	
EPI			
Duration (h) Mean	82.3	45.3	<0.001
Day 1 n (%)	518 (100)	586 (100)	
Day 2 n (%)	510 (98.5)	479 (81.7)	
Day 3 n (%)	493 (95.2)	137 (23.4)	

EPI = epidural; PCA = patient-controlled analgesia.

reduction in dizziness, pruritus, nausea, vomiting, and rescue antiemetic use (all $P < 0.001$, Table 7). For epidural use, patients also reported less pruritus, nausea, vomiting, and rescue antiemetic use ($P < 0.001$, Table 7).

Patient-Rated Satisfaction

Despite higher pain scores in audit 2, 87.5% rated the PCA technique as good compared with only 80.4% in audit 1 ($P < 0.001$, Table 8). Significantly fewer patients reported their postoperative PCA analgesic technique as fair or unsatisfactory ($P < 0.001$, Table 8). There was no statistically significant difference in the patient-rated satisfaction on epidural analgesia between the 2 time periods.

DISCUSSION

PCA has become the most commonly used analgesic technique now, but with a lower morphine consumption. Peripheral nerve block is gaining popularity. Postoperative pain scores were not improved whether PCA or epidural analgesia was used. Common side effects such as dizziness, nausea, and vomiting, as well as serious adverse events such as hypotension, bradypnoea, and hypoxia, were significantly reduced. Although patients reported higher satisfaction with PCA use, the same was not shown with epidural analgesia.

Formal establishment of the APS in Queen Mary Hospital, Hong Kong, took place in 1990. From 1992–1995 to 2002–2005, this service evolved with recruitment of more staff, including pain specialists and pain nurses. Modern acute pain management advocates the development of an APS team that

TABLE 5. Mean Pain Scores (Using NRS From 0 to 10) During the First, Second, and Third 24 Postoperative Hours Using Postoperative Analgesic

		2009–2012	1992–1995	P Value
PCA				
Day 1	Rest	2.3	2.6	<0.001
	Cough	5.3	5.1	0.051
Day 2	Rest	1.6	1.6	0.083
	Cough	4.7	4.3	<0.001
Day 3	Rest	1.5	1.4	0.003
	Cough	4.7	4.2	<0.001
EPI				
Day 1	Rest	1.8	1.7	0.986
	Cough	4.1	3.9	0.265
Day 2	Rest	1.3	1.0	0.025
	Cough	3.8	3.5	0.129
Day 3	Rest	0.9	0.4	<0.001
	Cough	3.5	3.3	0.768

Statistical method used: Mann–Whitney U test. EPI = epidural; PCA = patient-controlled analgesia.

TABLE 6. Incidence of Serious Adverse Events With Different Analgesic Techniques

	2009–2012	1992–1995	P Value
PCA			
Bradypnoea	0 (0.0)	6 (0.4)	<0.001
Hypoxia	0 (0.0)	20 (1.2)	<0.001
Reintubation	3 (0.1)	6 (0.4)	0.006
Hypotension	3 (0.1)	16 (1.0)	<0.001
Confusion	16 (0.3)	N.A.	N.A.
EPI			
Bradypnoea	0 (0.0)	2 (0.3)	0.501
Hypoxia	0 (0.0)	9 (1.5)	0.004
Reintubation	0 (0.0)	6 (1.0)	0.033
Hypotension	1 (0.2)	23 (3.9)	<0.001
Lower limb weakness	1 (0.2)	98 (16.7)	<0.001
PNB (only 2009–2012 data)			
Lower limb weakness	0 (0.0)		
Hypoxia	0 (0.0)		

Data in n (%). EPI = epidural; PCA = patient-controlled analgesia; PNB = peripheral nerve block.

TABLE 7. Incidence of Common Adverse Events With Different Analgesic Techniques

	2009–2012	1992–1995	P Value
PCA			
Dizziness	930 (16.8)	478 (29.8)	<0.001
Pruritus	195 (3.5)	132 (8.2)	<0.001
Nausea	1737 (31.4)	708 (44.1)	<0.001
Vomiting	685 (12.4)	396 (24.7)	<0.001
Antiemetic	21 (0.4)	183 (11.4)	<0.001
EPI			
Dizziness	51 (9.8)	72 (12.3)	0.198
Pruritus	13 (2.5)	103 (17.6)	<0.001
Nausea	82 (15.8)	172 (29.4)	<0.001
Vomiting	45 (8.7)	102 (17.6)	<0.001
Antiemetic	4 (0.8)	34 (5.8)	<0.001
PNB (only 2009–2012 results)			
Dizziness	6 (3.6)		
Pruritus	0 (0.0)		
Nausea	22 (13.3)		
Vomiting	6 (3.6)		
Antiemetic	0 (0.0)		

Data in n (%). EPI = epidural; PCA = patient-controlled analgesia, PNB = peripheral nerve block.

TABLE 8. Patient-Rated Satisfaction With Different Analgesic Techniques

	2009–2012	1992–1995	*P* Value
PCA			
Good	4276 (87.5)	1266 (80.4)	<0.001
Fair	512 (10.5)	242 (15.4)	<0.001
Unsatisfactory	8 (0.2)	16 (1.0)	<0.001
Unknown	90 (1.8)	51 (3.2)	<0.001
EPI			
Good	412 (92.8)	500 (85.9)	0.001
Fair	30 (6.8)	62 (10.7)	0.030
Unsatisfactory	1 (0.2)	6 (1.0)	0.120
Unknown	1 (0.2)	14 (2.4)	0.004
PNB (2009–2012 only)			
Good	134 (92.4)		
Fair	9 (6.2)		
Unsatisfactory	0 (0.0)		
Unknown	2 (1.4)		

Data in n (%). EPI = epidural; PCA = patient-controlled analgesia; PNB = peripheral nerve block.

consists of both anaesthetists and pain nurses.[17] Expert supervision by APS staff can improve postoperative pain relief and minimize side effects by offering patient selection and education, training of nursing staff, and the regular assessment of pain and treatment efficacy.[18,19] The advance in pain management techniques and pain medications with evidence-based support also contributes.[1] Acute postoperative pain management guidelines that include information on different analgesic techniques and postoperative monitoring have also been developed. This is reviewed and amended twice yearly based on updated evidence. Compared with the period from 1992 to 1995, education about APS is regularly offered to medical and nursing staff who are involved in postoperative pain management. This study gives us an overview of the changes over the last 2 decades and allows us to evaluate their impact. Moreover, regular audit in our APS aids us in identifying our strengths and potential areas for improvement.

Our demographic data suggest that our population is aging and also gaining weight. Elderly patients commonly have altered physiology, decreased opioid requirements, and increased comorbidities such as dementia, with higher risk postoperative cognitive dysfunction. Increasing numbers of obese patients and a higher incidence of obstructive sleep apnoea pose an increased risk of respiratory problems from opioid use. It is, however, encouraging to note that it seemed there was a reduction in the incidence of bradypnoea and hypoxia.

PCA has gained popularity since its introduction in 1971[20–22] and is also commonly used in the elderly now as it is safer than intramuscular injections.[23] Despite increased prescription for PCA for postoperative use, patient-reported NRS at rest has not improved and, in fact, appears to have increased slightly while coughing in days 2 and 3. The PCA regime in QMH is typically programmed with morphine as the opioid of choice, with a 1 mg bolus given over 1 min, a 5 min lockout, and an hourly upper limit of 0.1 mg per kg. The hourly limit has been adopted as it was felt that this would be safer. This raises the question whether the slightly higher NRS pain score is related to the presence of an hourly upper limit that restricts the amount given to the patients, especially for those with more major operations nowadays.[24] Other potential reasons accounting for the increase in pain scores include patient's fears of addiction or side effects, or PCA by itself is inadequate in providing the best postoperative analgesia. Macintyre and Jarvis suggested that the best predictor of morphine consumption is the age of the patient.[25] With this in mind, adjustments to the protocol such as lifting the hourly limit for younger patients may be necessary. With increased ward nursing staff education, concerns regarding improper use should diminish. It is interesting to note that, even with good patient education, patients' satisfaction and reported ability to control pain is also significantly affected by their confidence with the PCA design, with close to 50% of patients reporting not knowing if they would receive medicine when they pushed the PCA button.[26]

While NRS pain scores remain unchanged and have increased in certain circumstances, morphine consumption has decreased, which may be a result of adopting multimodal analgesia and its obvious advantages in reducing opioid consumption.[27] Recovery may also be enhanced with less opioid use. Regular adjuvant analgesics, including paracetamol, tramadol, nonsteroidal antiinflammatory drugs, and gabapentinoids, are more regularly prescribed to patients now once oral intake is allowed. PCA with a combination of morphine and ketamine for the postoperative period is not used in our center. A review by Carstensen and colleagues showed that there was no conclusive evidence to date to recommend postoperative ketamine use.[28] However, it may be worth considering in patients who have thoracic surgery where it has been shown to reduce pain scores, cumulative morphine consumption, and postoperative desaturation.[1] As an *N*-methyl-D-aspartate (NMDA) antagonist, it may improve the efficacy of opioids and reduce the development of chronic pain syndromes.[29] It is commonly used in major surgery but, postoperatively, may lead to hallucinations, nausea, dizziness, and blurred vision.

Epidural use following major surgery, especially colorectal, urological, gynaecological, and thoracic surgeries, has declined significantly in the last decade. This trend could be influenced by findings from The Multicenter Australian Study of Epidural Anesthesia and Analgesia in Major Surgery (MASTER) trial that found no differences in mortality or incidence of major morbidity in the epidural group compared with the group receiving intravenous opioids.[30,31] Moreover, advances in analgesic techniques and medications can help offer better postoperative analgesia, which make the choice of using epidural analgesia less favorable as epidural analgesia is not without risk and disadvantage. There was, however, a statistically significant increase in epidural use in upper gastrointestinal surgery. Significant postoperative pain, discomfort on coughing, patient's inability to have oral medications for longer periods, and the desire to avoid nausea and vomiting related to opioid use would have influenced the anaesthetist's choice to choose an epidural in such circumstances.

Peripheral nerve block techniques have also gained popularity over the last few years, especially in limb surgeries. Now, there have been interesting technologic advances such as ultrasound-guided peripheral nerve blocks and also declining trends on epidural analgesia, which is also based on the results of pain research in regional analgesia and anaesthesia. The increasing availability of ultrasound and well-described techniques have heralded a surge in ultrasound-guided peripheral nerve blocks.[32] While use of ultrasound has been associated with an increased overall success rate when compared with nerve stimulation, there is no proven research that ultrasound guidance reduces complication rates such as neurologic injuries.[33,34] Whether an increase in the use of regional blocks for analgesia after surgery improves pain relief and enhances recovery requires further study.

Side effects from PCA are a major concern for patients and medical staff.[20,21] With increasing experience, staff, and patient education, the prevalence of dizziness, pruritus, nausea, and vomiting has shown a statistically significant decline. The side effect that is most prevalent of these is nausea, with 31.9% of patients still experiencing it with PCA use, which is consistent with findings from other centres.[35,36] Metoclopramide was used for the management of postoperative nausea and vomiting (PONV) in the 1990s. A regime of intraoperative dexamethasone and ondansetron for patients in high-risk of PONV has been adopted. Identification of patients at higher risk of PONV and concomitant use of nonopioid-based analgesia has seen a significant decrease of this side effect. Propofol-based total intravenous anaesthesia has also become very popular in our center over the last decade and will reduce the incidence of PONV. However, even though a decrease in incidence was observed, the rate is still unacceptable and more work needs to be done.[36]

The most common side effect with epidural analgesia is also nausea and vomiting with 15.5% and 8.9% experiencing it. This could be related to opioid (fentanyl) in the infusion and also from hypotension that is exacerbated by sympatholysis from epidural analgesia, although the prevalence of hypotension following epidural analgesia has decreased to only 0.2% from 3.9% in 1992 to 1995. Likewise, the prevalence of lower limb weakness also decreased to 0.2% from 16.7%. This could be due to the use of lower concentrations of local anaesthetic namely 0.2% ropivacaine and 2 mcg/mL fentanyl that is used in our institution. A change from bupivacaine (1992–1995) to ropivacaine (2009–2012) for epidural infusion may also account for a lower incidence of lower limb weakness.

In 2009 to 2012, bradypnoea and hypoxia was not reported and hypotension decreased from 1.0% to 0.1% in patients prescribed PCA. There is now more than 20 years of experience in PCA use and PCA is now commonly prescribed. There are a few potential reasons accounting for the improved safety in this study. An hourly upper limit is set for PCA use. In fact, there is a lack of evidence that patients benefit from an hourly upper dose limit,[24] but this has been kept to increase patient safety. However, again, the hourly limit may attribute partially to the inferior pain relief. Regular multimodal analgesia with nonopioid analgesics has resulted in less opioid consumption. Education to the medical and nursing staff, as well as patients, about PCA has also led more appropriate and correct use of PCA. It can also help in identifying potential adverse events or complications earlier.

In general, there was a significant increase in patient satisfaction with analgesic techniques. However, we are cautious that such reports could be misleading as patients are often reluctant to criticize their treatment after surgery and when their satisfaction is also related to their expectation of pain relief, communication skills, and empathy expressed by health care providers.[37–39]

In conclusion, our current audit results show that postoperative pain management techniques have been changed with time. Although postoperative opioid consumption and side effects were reduced, such changes did not lead to better pain relief after operation. Further and continuous efforts and improvements are warrant to reduce acute pain relief and suffering of the patients after the surgery.

REFERENCES

1. Apfelbaum JL, Chen C, Mehta SS, et al. Postoperative pain experience: results from a national survey suggest postoperative pain continues to be undermanaged. *Anesth Analg.* 2003;97: 534–540.
2. PE Macintyre, DA Scott, SA Schug, EJ Visser, SM Walker. Acute Pain Management: Scientific Evidence (3rd Edition). 2010. ANZCA: Melbourne.
3. Taylor S, Voytovich AE, Kozol RA. Has the pendulum swung too far in postoperative pain control? *Am J Surg.* 2003;186:472–475.
4. Lucas CE, Vlahos AL, Ledgerwood AM. Kindness kills: the negative impact of pain as the fifth vital sign. *J Am Coll Surg.* 2007;205:101–107.
5. Gandhi K, Heitz JW, Viscusi ER. Challenges in acute pain management. *Anesthesiol Clin.* 2011;29:291–309.
6. Lavand'homme P. The progression from acute to chronic pain. *Curr Opin Anaesthesiol.* 2011;24:545–550.
7. American Society of Anesthesiologists Task Force on Acute Pain M. Practice guidelines for acute pain management in the perioperative setting: an updated report by the American Society of Anesthesiologists Task Force on Acute Pain Management. *Anesthesiology.* 2012;116:248–273.
8. Ready LB, Oden R, Chadwick HS, et al. Development of an anesthesiology-based postoperative pain management service. *Anesthesiology.* 1988;68:100–106.
9. Kwan A. Acute pain management in Hong Kong. *Hong Kong Med J.* 1996;2:381–384.
10. Hung CT, Lau LL, Chan CK, et al. Acute pain services in Hong Kong: facilities, volume, and quality. *Hong Kong Med J.* 2002;8:196–201.
11. Department of Anaestheiology, The University of Hong Kong. Clinical Services. http://www.anaesthesia.hku.hk/pain_medicine.php.
12. Joshi GP, Schug SA, Kehlet H. Procedure-specific pain management and outcome strategies. *Best Pract Res Clin Anaesthesiol.* 2014;28:191–201.
13. Usichenko TI, Rottenbacher I, Kohlmann T, et al. Implementation of the quality management system improves postoperative pain treatment: a prospective pre-/post-interventional questionnaire study. *Br J Anaesth.* 2013;110:87–95.
14. Argoff CE. Recent management advances in acute postoperative pain. *Pain Pract.* 2014;14:477–487.
15. Vickers A, Grady K. Raising the Standards: A Compendium of Audit Recipes. 3rd ed. London: Royal College of Anaesthetists; 2012.
16. Tsui SL, Irwin MG, Wong CM, et al. An audit of the safety of an acute pain service. *Anaesthesia.* 1997;52:1042–1047.
17. Rawal N. 10 years of acute pain services–achievements and challenges. *Reg Anesth Pain Med.* 1999;24:68–73.
18. Bardiau FM, Taviaux NF, Albert A, et al. An intervention study to enhance postoperative pain management. *Anesth Analg.* 2003;96:179–185.
19. Mann C, Ouro-Bang'na F, Eledjam JJ. Patient-controlled analgesia. *Curr Drug Targets.* 2005;6:815–819.
20. Sechzer PH. Studies in pain with the analgesic-demand system. *Anesth Analg.* 1971;50:1–10.
21. Smythe M. Patient-controlled analgesia: a review. *Pharmacotherapy.* 1992;12:132–143.

22. Momeni M, Crucitti M, De Kock M. Patient-controlled analgesia in the management of postoperative pain. *Drugs.* 2006;66:2321–2337.
23. Egbert AM, Parks LH, Short LM, et al. Randomized trial of postoperative patient-controlled analgesia vs intramuscular narcotics in frail elderly men. *Arch Intern Med.* 1990;150:1897–1903.
24. Macintyre PE. Safety and efficacy of patient-controlled analgesia. *Br J Anaesth.* 2001;87:36–46.
25. Macintyre PE, Jarvis DA. Age is the best predictor of postoperative morphine requirements. *Pain.* 1996;64:357–364.
26. Patak LS, Tait AR, Mirafzali L, et al. Patient perspectives of patient-controlled analgesia (PCA) and methods for improving pain control and patient satisfaction. *Reg Anesth Pain Med.* 2013;38:326–333.
27. Elvir-Lazo OL, White PF. The role of multimodal analgesia in pain management after ambulatory surgery. *Curr Opin Anaesthesiol.* 2010;23:697–703.
28. Carstensen M, Moller AM. Adding ketamine to morphine for intravenous patient-controlled analgesia for acute postoperative pain: a qualitative review of randomized trials. *Br J Anaesth.* 2010;104:401–406.
29. Laskowski K, Stirling A, McKay WP, et al. A systematic review of intravenous ketamine for postoperative analgesia. *Can J Anaesth.* 2011;58:911–923.
30. Rigg JR, Jamrozik K, Myles PS, et al. Epidural anaesthesia and analgesia and outcome of major surgery: a randomised trial. *Lancet.* 2002;359:1276–1282.
31. Peyton PJ, Myles PS, Silbert BS, et al. Perioperative epidural analgesia and outcome after major abdominal surgery in high-risk patients. *Anesth Analg.* 2003;96:548–554.
32. Torrillo TM, Rosenblatt MA. Meta-analyses of ultrasound-guided versus traditional peripheral nerve block techniques–are we comparing apples and oranges? *J Clin Anesth.* 2011;23:87–89.
33. Gelfand HJ, Ouanes JP, Lesley MR, et al. Analgesic efficacy of ultrasound-guided regional anesthesia: a meta-analysis. *J Clin Anesth.* 2011;23:90–96.
34. Neal JM. Ultrasound-guided regional anesthesia and patient safety: an evidence-based analysis. *Reg Anesth Pain Med.* 2010;35(2 Suppl):S59–67.
35. Culebras X, Corpataux JB, Gaggero G, et al. The antiemetic efficacy of droperidol added to morphine patient-controlled analgesia: a randomized, controlled, multicenter dose-finding study. *Anesth Analg.* 2003;97:816–821.
36. Gan TJ, Diemunsch P, Habib AS, et al. Consensus guidelines for the management of postoperative nausea and vomiting. *Anesth Analg.* 2014;118:85–113.
37. Chumbley GM, Hall GM, Salmon P. Patient-controlled analgesia: an assessment by 200 patients. *Anaesthesia.* 1998;53:216–221.
38. Egan KJ, Ready LB. Patient satisfaction with intravenous PCA or epidural morphine. *Can J Anaesth.* 1994;41:6–11.
39. Etches RC. Patient-controlled analgesia. *Surg Clin North Am.* 1999;79:297–312.