A Large-Scale Study Assessing Gender Differences in Postoperative Patient-Controlled Analgesia in Chinese Population

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Abstract: The effects of gender differences on postoperative pain control and analgesic consumption are inconclusive although current studies suggest that women report more pain than men in severity, frequency and duration. This study aims to study the gender differences in postoperative pain relief and morphine consumption using patient-controlled analgesia (PCA) in a single institution between years of 2002 and 2007. Common side effects of PCA morphine use and satisfaction of patients for postoperative pain control between the genders were also assessed. More than 7000 patients were evaluated. The overall pain scores of females were significantly higher from postoperative day 1 to day 3 (all $p<0.05$). However, total morphine consumption was higher for males than females (12.6 μg/kg/h vs. 10.7μg/kg/h respectively, $p<0.01$). A substantial proportion of female patients experienced common side effects such as nausea, vomiting and dizziness (all $p<0.01$) despite they used less morphine. More male patients ranked PCA for pain relief as good than females (82.1% vs. 79.3%, $p<0.003$). We conclude that, in our Chinese population, females had significantly higher postoperative pain scores but used less PCA morphine. They also experienced more common side effects of opioids with low satisfaction in pain relief when using postoperative PCA. Our large-scale study provides further insight into the postoperative pain control behavior between genders of Chinese patients.

Keywords: Patient-Controlled Analgesia, Gender Differences, Chinese, Pain Management.

1. INTRODUCTION

Based on population surveys, women have reported more severity, frequency, and duration of pain in comparison to men [1]. This phenomenon has also been noted to occur in the peri-operative setting. Studies have noted that females possessed greater procedural and post-operative pain [2-6].

Although the reporting of pain between genders differs, it remains unclear whether this gender difference exists with respect to analgesic consumption in the peri-operative period. Some studies have suggested that there is no gender difference in patient-controlled analgesia (PCA) [7] or post-operative narcotic consumption [3], while others have indicated that either males asked for more analgesic during the procedure [8] or PCA usage [9], or that females required more narcotic for post-operative pain relief [5, 6]. As such, it continues to remain speculative if gender plays a role in morphine use for postoperative PCA. Understanding such gender variations can lead to more personalized medical treatment, decreased side-effects, and reduction of health-care costs. Therefore, the main objective of this study based on the largest cohort in the assessment of postoperative PCA usage was to address gender differences in pain relief and morphine consumption in the immediate post-operative period (from postoperative day 1 to 3). Secondary objectives of this study addressed PCA-related side-effects, and patient satisfaction in overall postoperative pain control.

2. METHODS

This study was conducted at Queen Mary Hospital, a tertiary referral teaching hospital in Hong Kong, and was approved by the local Institutional Ethics Committee. Data were collected from patient records kept by the Acute Pain Service of the Department of Anaesthesiology. All acute pain service records for patients who were cared by the Acute Pain Service, Pain Management Team, Department of Anaesthesiology between January, 2002 to December, 2007 and were prescribed with PCA with morphine after surgery were traced and retrospectively assessed. All the records were reviewed and validated by two investigators independently, and any variations were discussed and a consensus was obtained. Patients with the following conditions were excluded from the study: PCA had not been started after prescription, or did not start within the first day after surgery (e.g. patients who remained mechanically ventilated in the intensive care unit after surgery); other acute pain

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control modalities (e.g. epidural anaesthesia and peripheral nerve block) were applied before PCA, essential data (e.g. PCA configuration) were missing; error occurred to the PCA machine (which resulted in resetting dosage count), patients who were not able to understand how to use PCA; patients who were physically unfit for PCA; PCA was terminated because of re-operation, deterioration of patient's condition, or loss of venous access; and patients who were participating in other research projects.

All patients were monitored in the recovery area after surgery. Vital signs including blood pressure, oxygen saturation (SpO_2) and electrocardiogram as well as numerical rating scale (NRS) of pain scores at rest and during cough (0 represents no pain, and 10 indicates the most severe pain that patient could imagine) were assessed every 5 minutes for at least 30 minutes before discharging back to the general ward. Morphine was given intravenously to patients by the attending anaesthetist until the NRS pain score was 3 or less. The PCA machine (Graseby 3300 Syringe Pump, Smiths Medical, London) was then connected to the patient *via* a dedicated intravenous line or a non-reflux valve. The PCA machine was placed at or below the patient's heart level to avoid siphoning. Patients were taught how to use PCA by the attending anaesthetist.

During the study period, a standard PCA morphine protocol was used. The concentration of morphine was standardized to 1mg per ml and was diluted by 0.9% normal saline. The PCA machine was programmed to administer a bolus (1mg to 1.5mg), five minute lockout interval, and possess a one hour maximum dose limit approximately 0.1mg/kg for patients less than 65 years of age and 0.075mg/kg for patients greater than 65 years of age. No baseline infusion was prescribed. Intramuscular pethidine or morphine injection was prescribed as rescue pain medication. The pain team was notified immediately in case of inadequate pain relief. Amount of morphine use by PCA was tabulated for postoperative days 1 to 3.

All patients were closely monitored after transfer back to the general ward postoperatively. SpO_2 was monitored continuously for at least 24 hours after surgery. Respiratory rate and sedation score were observed hourly, and then every four hours when the patients were stable. Blood pressure, pulse, NRS pain score at rest and during cough, PCA demand and delivery counts, as well as cumulative dose were recorded every four hours. Rescue pain medication and the use of anti-emetics were also noted. All side-effects and complications were also charted. Metoclopramide 10 mg up to every four hours was prescribed to be given intravenously for postoperative nausea and vomiting (PONV) on patient demand. Ondansetron was reserved for patients with PONV refractory to this treatment. The APS team or the on-call anaesthetist was informed if a severe adverse event occurred. These included loss of consciousness (unarousable and a sedation score of 3 or less, see Appendix 1), bradypnoea (respiratory rate less than 10 per minute), hypotension (systolic blood pressure less than 90 mmHg), hypercapnoea ($PaCO_2 > 7kPa$), or oxygen desaturation ($SpO_2 < 90\%$). When any of these events occurred, PCA was immediately suspended, and the patient was managed accordingly. Naloxone was given intravenously to patients with respiratory depression if necessary. PCA might be restarted when the clinical condition improved, after a thorough review of the patient, the drug dose and consumption, and the PCA setting by the APS team.

All patients who received PCA treatment were assessed by our pain management team every day. NRS pain score at rest and during coughing, drug demand and delivery counts, cumulative dose of morphine used, any rescue pain medications used, any anti-emetics used, and any complications and the severity were noted. If oral intake was allowed, oral adjuvant analgesic such as paracetamol, non-steroid anti-inflammatory drugs (NSAIDs) and opioids (including dextropropoxyphene and dihydrocodine) might be prescribed at the discretion of the acute pain team anaesthetist. PCA was terminated if the NRS was 3 or less, daily morphine consumption was less than 0.1mg/kg, or on patient's request. Oral analgesic medication and rescue analgesic were continued after stopping the PCA. Patient's satisfaction about using the PCA was assessed on termination of the PCA. Patient satisfaction was graded as good, fair, or unsatisfactory. For the grade of "fair" or "unsatisfactory," patients were asked for the reasons that led to such perception.

Each patients' medical charts were assessed to account for demographics, type of operation, pain score (NRS) up to 72 hours postoperatively, morphine consumption on different types of operations, side-effects and complications during the use of PCA morphine, and patient satisfaction about PCA use. However, different types of surgery may have different analgesic requirement. As such, operation-types were divided as followed: head and neck, breast surgery, upper gastrointestinal, hepatobiliary and pancreatic,

colorectal surgery, urological, gynaecological, spine, limbs, and thoracic surgeries as well as unclassified laparotomy and unclassified operation. Operations involving abdominal incisions but not involving major organ systems were classified into "unclassified laparotomy". Other procedures that did not fit into any categories were classified into "unclassified operation".

All data was coded and entered on a spreadsheet. Statistical analysis was performed using SPSS 14.0 for Windows (SPSS Inc., IL, USA). Pain scores, drug demand and delivery counts, and morphine consumption among groups were compared using Mann-Whitney U or Kruskal-Wallis test, as appropriate. Categorical data were analyzed with Chi-Square test or Fisher's Exact test as appropriate. The threshold for the statistical significance was established at $p<0.05$.

3. RESULTS

Between the period 1st January 2002 and 31st December 2007, eight thousand eight hundred and fifty six post-operative patients used PCA. Eight hundred and eight patients did not start the PCA within 1st day after surgery. Nineteen patients received pain management other than PCA. Two hundred and six patient's records had essential data missing. Fifteen patients had PCA machine error while 59 were not able to understand how to use PCA. PCA were terminated in 165 patients because of re-operation, deterioration of patient's condition or loss of venous access. Three hundred and twenty four patients were participating in other research projects. As such, totally 7,260 patients were eligible for inclusion in the study.

The distribution of different operation-types between gender was showed at Table **1**. For the demographic data, age, body weight (kg), drinking and smoking status, hypertension, ischaemic heart disease and chronic obstructive airway disease (COAD) were significantly higher in males than in females ($p<0.05$). A higher percentage of females were classified as ASA I ($p<0.05$, Table **2**).

Regarding postoperative pain scores**,** females overall had significantly higher resting NRS pain score from day 1 to day 3 as shown from Tables **3** to **5** ($p<0.05$). These significant differences were also observed for patients undergoing colorectal surgery (day 1, resting NRS pain scores), head and neck surgery (day 2, NRS pain scores both at rest and during coughing), hepatobiliary and pancreatic surgery (day 2, NRS pain scores both at rest and during coughing, day 3 at rest) and limb surgery (day 3, NRS pain scores during coughing). However, the overall morphine consumption was significantly higher in males ($p<0.001$) as at Table **6**. If divided into different operation categories, these significant differences were also observed in head and neck surgery, upper gastrointestinal surgery, hepatobiliary and pancreatic surgery, colorectal surgery, urological surgery, spine,

Table 1: Distribution of Operation-Types between Males and Females. Value in Number

	Male	Female
In different OT types		
Head and neck	265	133
Breast	0	85
Upper gastrointestinal	265	176
Hepatobiliary and pancreatic	1193	607
Colorectal	954	699
Urological	218	128
Gynaecological	0	1124
Other laparotomy	118	80
Spine	182	123
Limb	323	412
Trunk	22	25
Thoracic including oesophageal	42	14
Unclassified	42	30
All Cases	3624	3636

Table 2: Demographic Data. Values in Median (Range) or Percentage (Number)

	Male	Female	*p* value
Age (years)	59 (10 – 100)	53 (8 – 97)	<.001**
Body weight (kg)	62 (27.6 – 123)	53 (19.8 – 118)	<.001**
Ever drinker	11.3% (408)	1.4% (51)	<.001**
Ever smoker	24.3% (882)	2.8% (101)	<.001**
ASA#			
I	16.8% (572)	27.4% (934)	<.001**
II	60.5% (2056)	54.9% (1873)	
III or above	22.7% (770)	17.7% (602)	
Diabetes mellitus	3.7% (134)	3% (108)	0.084
Hypertension	9.1% (329)	7.6% (276)	0.022**
Ischaemic heart disease	2.1% (77)	1.4% (50)	0.015**
Chronic obstructive airway disease	1% (36)	0.4% (13)	0.001**
Asthma	0.4% (14)	0.2% (8)	0.197
Chronic renal failure	0.7% (25)	0.6% (20)	0.448

**significant at the 0.05 level.
#The percentage of ASA I was significantly higher in Female than in Male (p<0.001), while the percentage of ASA III & above was significantly higher in Male than in Female (p<0.001).

Table 3: Numerical Rating Scale (NRS) Pain Scores at Postoperative Day 1. Values in Median [IQR]

	Male			Female			*P value*	
Types of operation	***n***	**Rest**	**Cough**	***n***	**Rest**	**Cough**	**Rest**	**Cough**
Head and neck	262	2 [0 – 3]	5 [3 – 6]	131	2 [0 – 4]	5 [3 – 7]	0.410	0.185
Breast	0	–	–	85	1 [0 – 3.5]	4 [2 – 6]	–	–
Upper gastrointestinal	264	2 [0 – 4.8]	6 [5 – 8]	176	3 [1 – 4.8]	7 [5 – 8]	0.597	0.860
Hepatobiliary and pancreatic	1176	2 [0 – 3]	6 [4 – 7]	600	2 [1 – 4]	6 [5 – 8]	0.107	0.070
Colorectal	946	2 [0 – 4]	7 [5 – 8]	691	2 [0 – 5]	7 [5 – 8]	0.010**	0.232
Urological	217	2 [0 – 3]	5 [4 – 8]	126	1 [0 – 3]	6 [4 – 8]	0.475	0.511
Gynaecological	0	–	–	1122	2 [0 – 4]	5 [4 – 7]	–	–
Other laparotomy	115	2 [0 – 4]	6 [4 – 8]	79	2 [1 – 4]	6 [5 – 7]	0.377	0.538
Spine	181	2 [0 – 3]	5.5 [4 – 7.8]	121	2 [0 – 5]	6 [4 – 8]	0.335	0.060
Limb	321	2 [0 – 4]	5 [4 – 7]	410	2 [0 – 4]	5 [4 – 8]	0.367	0.240
Trunk	22	3 [0.8 – 3.3]	6 [6 – 8]	25	2 [1 – 4]	5 [3 – 7.5]	0.983	0.327
Thoracic including oesophageal	42	2 [1 – 3]	6 [4.5 – 7]	14	2.5 [1.75 - 5]	7 [5 – 7]	0.114	0.381
Unclassified	41	2[0 – 3.5]	6 [3.5 – 7.5]	30	2 [0 – 4.3]	5 [4.8 – 8]	0.656	0.541
All cases	3587	2 [0 – 4]	6 [4 – 8]	3610	2 [0 – 4]	6 [4 – 8]	0.001**	0.506

**significant at the 0.05 level (the pain scores in Female were significantly higher than that in Male).
IQR = interquartile range [Q1 – Q3].

Table 4: Numerical Rating Scale (NRS) Pain Scores at Postoperative Day 2. Values in Median [IQR]

	Male			Female			*P value*	
Types of operation	***n***	**Rest**	**Cough**	***n***	**Rest**	**Cough**	**Rest**	**Cough**
Head and neck	201	1 [0 - 3]	4 [2.3 – 5.8]	89	2 [0 - 4]	5 [3 - 6]	0.011**	0.015**
Breast	0	–	–	31	2 [0 - 3]	5 [3 - 7]	–	–
Upper gastrointestinal	253	1 [0 - 2]	5 [4 - 7]	173	1 [0 – 3]	5 [4 - 7]	0.285	0.931
Hepatobiliary and pancreatic	1121	1 [0 - 2]	5 [3 - 6]	570	1 [0 - 3]	5 [4 - 7]	0.011**	0.027**
Colorectal	894	1 [0 - 2]	5 [4 - 7]	657	1 [0 - 3]	5 [4 - 7]	0.123	0.252
Urological	188	1 [0 - 2]	5 [4 – 7]	106	1 [0 - 3]	5 [3 – 7]	0.903	0.909
Gynaecological	0	–	–	503	1 [0 - 3]	4 [3 – 6]	–	–
Other laparotomy	113	1 [0 - 2]	5 [3 – 6]	75	1 [0 - 3]	5 [4 – 7]	0.308	0.086
Spine	143	1 [0 - 3]	5 [4 – 7]	87	2 [0 - 4]	6 [4 – 8]	0.094	0.059
Limb	234	1.5 [0 - 3]	5 [3 – 6]	285	1 [0 - 3]	5 [3 – 7]	0.635	0.127
Trunk	18	1 [0 - 2]	5 [3 – 7]	17	2 [0.5 - 4]	6 [5 – 8]	0.278	0.279
Thoracic including oesophageal	38	1.5 [0 - 2]	5 [3.5 – 6]	13	2 [1 – 2.5]	5 [4 – 7.5]	0.468	0.347
Unclassified	31	1 [0 - 3]	5 [2 – 6]	16	1 [0.3 – 3.8]	4.5 [3 – 5.5]	0.628	0.650
All cases	3234	1 [0 - 2]	5 [3 - 7]	2621	1 [0 - 3]	5 [4 - 7]	<.001**	0.104

**significant at the 0.05 level (the pain scores in Female were significantly higher than that in Male).
IQR = interquartile range [Q1 – Q3].

Table 5: Numerical Rating Scale (NRS) Pain Scores at Postoperative Day 3. Values in Median [IQR]

	Male			Female			*P value*	
Types of operation	***n***	**Rest**	**Cough**	***N***	**Rest**	**Cough**	**Rest**	**Cough**
Head and neck	127	1 [0 - 3]	4 [2 - 6]	52	1 [0 – 3]	4 [3 – 5]	0.849	0.946
Breast	0	–	–	6	2 [0 – 3.5]	4.5 [3.8 – 6.5]	–	–
Upper gastrointestinal	218	0 [0 - 2]	4 [3 - 6]	133	1 [0 – 2]	5 [3 - 6]	0.394	0.118
Hepatobiliary and pancreatic	700	1 [0 - 2]	4 [3 - 6]	365	1 [0 - 2]	5 [3 - 6]	0.004**	0.121
Colorectal	657	1 [0 - 2]	5 [3 - 6]	436	1 [0 - 2]	5 [3 - 6]	0.836	0.633
Urological	90	1 [0 - 2]	5 [3 – 6]	42	0 [0 - 3]	5 [4 – 7]	0.988	0.619
Gynaecological	0	–	–	92	1 [0 - 2]	4 [3 – 5]	–	–
Other laparotomy	93	0 [0 - 2]	4 [3 – 5]	66	1 [0 - 2]	4 [3 – 6]	0.124	0.664
Spine	65	0 [0 - 3]	5 [3 – 6]	48	1.5 [0 - 3]	6 [3 – 7]	0.217	0.446
Limb	103	1 [0 - 3]	5 [3 – 6]	122	1 [0 - 3]	5 [4 – 7]	0.504	0.037**
Trunk	8	1 [0 – 3.5]	7 [4.3 – 7.8]	9	3 [0 - 5]	7 [4 – 8]	0.316	0.961
Thoracic including oesophageal	29	1 [0 - 2]	4 [3 – 7]	7	2 [0 - 4]	7 [5 – 8]	0.295	0.153
Unclassified	17	2 [0 - 4]	6 [3.5 – 7]	5	3 [2 - 4]	5 [3 – 7]	0.248	0.550
All cases	2107	1 [0 - 2]	5 [3 - 6]	1383	1 [0 - 2]	5 [3 - 6]	0.002**	0.076

**significant at the 0.05 level (the pain scores in Female were significantly higher than that in Male).
IQR = interquartile range [Q1 – Q3].

Table 6: Total Morphine Consumption (mg). Values in Median [IQR]

Types of operation	Male	Female	*P value*
Head and neck	21 [8 – 58.3]	15 [4 – 33]	0.001**
Breast	–	6 [2 – 14.9]	–
Upper gastrointestinal	66.2 [40.6 – 108]	45.9 [26.4 – 71.8]	<.001**
Hepatobiliary and pancreatic	46 [25 – 80]	38 [23 – 63]	<.001**
Colorectal	51 [26 – 81.1]	35 [20 – 61.6]	<.001**
Urological	35 [16.4 – 63]	23 [9.7 – 45.1]	0.006**
Gynaecological	–	17 [9 - 28]	–
Other laparotomy	53 [27.9 – 73]	40 [22.3 – 84.4]	0.250
Spine	33 [15 – 60.2]	25 [9.2 - 50]	0.044**
Limb	32 [15 – 60.6]	20 [9.5 – 38.4]	<.001**
Trunk	35.3 [12.8 – 62.1]	15 [7.3 – 45]	0.119
Thoracic incl. oesophageal	83.4 [22 – 140.3]	33.3 [12.3 – 64]	0.061
Unclassified	34.2 [13.9 – 64.3]	13.5 [4.8 – 28.7]	<.001**
All cases	45 [22 – 78.5]	25 [12 – 46]	<.001**

**significant at the 0.05 level.

Table 7: Morphine Consumption per Body Weight per PCA hour ($\mu g.kg^{-1}.hr^{-1}$). Values in Median [IQR]

Types of operation	Male	Female	*P value*
Head and neck	8.4 [3.7 – 16.7]	6.6 [3.1 – 12.7]	0.025**
Breast	–	5.3 [1.7 – 10.6]	–
Upper gastrointestinal	16 [10.2 – 23.6]	14.1 [9.1 – 19.0]	0.008**
Hepatobiliary and pancreatic	12.7 [8.1 – 18.8]	12.4 [8.6 – 18.9]	0.797
Colorectal	13.5 [8.1 – 19.8]	12.6 [7.2 – 18.4]	0.053
Urological	10.3 [6.1 – 15.8]	8.9 [5.4 – 16.9]	0.586
Gynaecological	–	10.3 [5.6 – 16.2]	–
Other laparotomy	11.9 [7.6 – 18.5]	12.9 [5.6 – 19.6]	0.612
Spine	11.5 [6.3 – 18.8]	10.1 [5.8 – 16.1]	0.263
Limb	11 [6.4 – 18.6]	8.0 [5.2 – 12.9]	<.001**
Trunk	12.2 [10 – 17.7]	7.9 [4.2 – 12.1]	0.054
Thoracic incl. oesophageal	18.2 [7.9 – 28.9]	23.9 [7.4 – 25.9]	0.929
Unclassified	13.3 [7.4 – 20]	7.7 [3 – 10.7]	0.010**
All cases	12.6 [7.5 – 19.2]	10.7 [6.2 – 16.8]	<.001**

**significant at the 0.05 level.

limb and unclassified surgery ($p<0.05$). When morphine consumption per body weight per PCA hour was evaluated, it was also significantly higher in males in all cases, head and neck surgery, upper gastrointestinal surgery, limb and unclassified surgery ($p<0.05$, Table **7**).

Assessing side-effects, a significantly higher prevalence of females suffered from nausea, vomiting and dizziness as shown in Tables **8-10**. Overall, males were more satisfied about the efficacy of the PCA as compared with females ($p=0.003$, Table **11**).

Table 8: Adverse Effects - Nausea. Values in Percentage (Number)

Types of operation	Male	Female	*P value*
Head and neck	26.9% (71)	53.4% (71)	<.001**
Breast	–	45.9% (39)	–
Upper gastrointestinal	19.6% (52)	42.6% (75)	<.001**
Hepatobiliary and pancreatic	37.2% (444)	56.7% (344)	<.001**
Colorectal	35.3% (336)	52.2% (365)	<.001**
Urological	45.4% (99)	65.6% (84)	<.001**
Gynaecological	–	62.1% (697)	–
Other laparotomy	32.2% (38)	53.8% (43)	0.002**
Spine	34.1% (62)	61.8% (76)	<.001**
Limb	39% (126)	57.8% (238)	<.001**
Trunk	18.2% (4)	44% (11)	0.058
Thoracic incl. oesophageal	33.3% (14)	57.1% (8)	0.114
Unclassified	33.3% (14)	60% (18)	0.025**
All cases	34.8% (1260)	56.9% (2069)	<.001**

**significant at the 0.05 level.

Table 9: Adverse Effects - Vomiting. Values in Percentage (Number)

Types of operation	Male	Female	*P value*
Head and neck	11% (29)	36.8% (49)	<.001**
Breast	–	18.8% (16)	–
Upper gastrointestinal	6% (16)	6.8% (12)	0.742
Hepatobiliary and pancreatic	10.3% (123)	20.6% (125)	<.001**
Colorectal	9.3% (89)	19.2% (134)	<.001**
Urological	11.9% (26)	43% (55)	<.001**
Gynaecological	–	25.6% (287)	–
Other laparotomy	11% (13)	13.8% (11)	0.563
Spine	13.7% (25)	30.1% (37)	0.001**
Limb	19.8% (64)	39.8% (164)	<.001**
Trunk	13.6% (3)	28% (7)	0.297
Thoracic incl. oesophageal	9.5% (4)	21.4% (3)	0.350
Unclassified	14.3% (6)	36.7% (11)	0.027**
All cases	11% (398)	25.1% (911)	<.001**

**significant at the 0.05 level.

Table 10: Adverse Effects - Dizziness. Values in Percentage (Number)

Types of operation	Male	Female	*P value*
Head and neck	21.% (56)	32.3% (43)	0.015**
Breast	–	31.8% (27)	–
Upper gastrointestinal	18.1% (48)	30.7% (54)	0.002**
Hepatobiliary and pancreatic	28.8% (344)	44.5% (270)	<.001**
Colorectal	13.3% (127)	28.5% (199)	<.001**
Urological	34.4% (75)	39.1% (50)	0.384
Gynaecological	–	44.9% (505)	–
Other laparotomy	22.9% (27)	32.5% (26)	0.134
Spine	19.2% (35)	33.3% (41)	0.005**
Limb	17.6% (57)	25.7% (106)	0.009**
Trunk	4.5% (1)	36% (9)	0.012**
Thoracic incl. oesophageal	23.8% (10)	28.6% (4)	0.722
Unclassified	14.3% (6)	26.7% (8)	0.191
All cases	21.7% (786)	36.9% (1342)	<.001**

**significant at the 0.05 level.

Table 11: Percentage of Patient's Satisfaction Graded as 'Good'. Values in Percentage (Number)

Types of operation	Male	Female	*P value*
Head and neck	79.1% (204)	79.5% (101)	0.917
Breast	–	65.9% (54)	–
Upper gastrointestinal	85.8% (224)	81.1% (142)	0.192
Hepatobiliary and pancreatic	81.9% (957)	83.3% (500)	0.465
Colorectal	82.6% (776)	80.9% (554)	0.362
Urological	84.1% (180)	83.1% (103)	0.801
Gynaecological	–	77.7% (862)	–
Other laparotomy	93.8% (105)	81.2% (65)	0.007**
Spine	80.7% (146)	75% (90)	0.242
Limb	77.5% (241)	79.5% (321)	0.526
Trunk	77.3% (17)	72% (18)	0.679
Thoracic incl. oesophageal	75% (30)	53.8% (7)	0.177
Unclassified	82.5% (33)	62.1% (18)	0.056
All cases	82.1% (2913)	79.3% (2835)	0.003**

**significant at the 0.05 level.

4. DISCUSSION

A significant higher percentage of male patients suffered from hypertension and ischaemic heart disease in this study. Tostes *et al*. [10] also had similar findings, and the reasons were still not well established. Higher percentage of males were alcoholic

drinkers and smokers, it also corresponded to some local studies done in the Hong Kong population [11, 12]. A higher smoking population was one of the reasons accounting for significant higher COAD percentage in male [13]. The median age of females was significantly younger than males. A large number of female patients suffered from gynaecological problems, and this group of patient was usually younger, which may account for the variation.

We demonstrated that females generally had a higher pain score in our study. Review done by Unruh [1] suggested that females reported a greater amount of frequency, duration, and severity of pain in comparison to males. They also have higher risk of pain related disability than men. Taenzer [3] and Rosseland and Stubhaug [4] also showed that females reported more pain after arthroscopic surgery. Therefore, gender difference may be a confounding factor in pain research. Logan and Rose [14] studied the gender differences in using PCA for postoperative pain among adolescent surgical patients. They found that adolescent females experienced more pain in the post-operative period and had more pre-operative anxiety than males. This difference extended to elderly as Tsai [15] showed that Chinese female patients suffered more pain and had greater depressive tendencies than males. The impact of gender on pain sensitivity, perception or behavior therefore has been suggested to be related to age [1]. The mechanisms to explain such findings were not fully understood. However, biological mechanisms, such as genetic and hormonal differences between males and females, psychological mechanisms such as differences in pre-operative anxiety and depressive tendency, and social factors, such as gender roles difference, may be possible factors [14, 15].

Greater pain intensity may not be associated with more morphine consumption. Previous study showed that postoperative PCA morphine consumption was significantly reduced when compared with that of 10 years ago but not pain scores and incidence of side effect by Cheung *et al.* [16]. Nevertheless, the authors did not evaluate the difference in gender in pain scores and morphine consumption. From our study, males used more morphine compared with females. This difference still persisted when taking body weight difference into account. However, the results in gender difference in postoperative opioid are not conclusive. Previous studies suggested that females required higher dose of narcotics compared with males [5, 6]. Logan and Rose [14] suggested that no significant difference existed in PCA usage between male and female adolescents postoperatively. Miaskows and Levine [17] reviewed studies in which PCA were used from 1966 to 1998, noting that slightly more studies suggested that males consumed more narcotics than females. Moreover, Chia *et al.* [9] showed a similar finding in Chinese patient population as our study. Ethnic group differences were noted in reported pain and morphine consumption. Postoperative PCA morphine consumption was higher in Indian patients compared with Chinese and Malay patients [18]. Therefore, ethnicity may also be one of the factors accounting for the gender difference in pain and postoperative opioid consumption.

Animal studies suggested that the gender difference in opioid consumption may be due to the difference in opioid receptor sensitivities, difference in tolerance development and neurochemical systems that participated in the analgesic response [19]. For humans, other factors need to be taken into account, such as sex difference in fear of addiction, previous pain experience, psychological status of the patients, tolerance to postoperative pain and side-effects related to opioids [17]. Based on our study, a significantly higher prevalence of females suffered from side-effects related to opioid use, such as nausea, vomiting and dizziness. Studies by Cepeda *et al.* [20] and Lee *et al.* [21] also demonstrated similar results that the probability of nausea and vomiting when using opioid for postoperative pain relief was higher for females. The difference in the incidence of side-effects may be one of the reasons for the difference in PCA morphine consumption between males and females. These differences helped us to understand why females suffered from higher pain intensity but used less morphine. However, theses finding may also be a reflection of gender differences in the sensitivity to opioids, both the analgesic effects and side-effects. Further studies are warrant to clarify the relationship between pain scores, opioid consumption, and side-effects between males and females.

Based on our study, patient satisfaction was significantly lower in females. Patient's satisfaction is also affected by their preferences and expectation of pain relief, as well as the communication skills and empathy expressed by the health care providers [22, 23]. In this study, unsatisfactory pain relief was reflected by a higher pain scores and high incidence of side effects such as nausea, vomiting and dizziness, which may be one of the reasons for lower satisfaction of females than males. Better prevention of these side-

effects, such as adequate hydration and regular antiemetic treatment, may help the reduction of side-effects. Such strategies may encourage female patients to use more PCA, resulting in improved pain relief and higher satisfaction.

This study represents the largest study assessing morphine consumption and PCA usage in gender difference, in particular in the Chinese population. Our study showed that females had a higher post-operative pain score; however, they used less PCA morphine and had a higher incidence of side-effects. Better preventive treatment on the side-effects may help to improve patient satisfaction on PCA usage, which may also translate into improved outcomes and reduced health-care costs. Furthermore, our large-scale study provides further insight into the pain control behavior of Chinese patients, which can provide further insight into this ethnic population for comparisons to other ethnicities. In addition, understanding that gender differences may exist may provide the foundation to address future studies that may explore the various biological/genetic, psychological, and social/cultural underpinnings related to such findings, which may ultimately aid in more personalized medical care.

APPENDIX 1

Sedation Score

0 = Awake, spontaneous eye opening

1 = Drowsy

2 = Sleeping but arousable

3 = Unconscious and unarousable

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