The clinical application of preoperative self-anticipated pain score and the correlation with surgical pain after elective surgery - a prospective observational study

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Abstract

Background Current principles of postoperative pain management are primarily based on the types and extent of surgical intervention. This clinical study measured patient's self-anticipated pain score before surgery, and correlated the scores with the pain levels and analgesic requirements after surgery. Methods This prospective observational study recruited consecutive patients who received elective surgery in the E-Da Hospital, Taiwan from June to August 2018. Patients were asked to subjectively rate their highest anticipated pain level (numerical rating scale, 0-10) for the scheduled surgical interventions during their preoperative anesthesia assessment. After the operation, the actual pain intensity (NRS 0-10) experienced by the patient in the post-anesthesia care unit and the total dose of opioids administered during the perioperative period were recorded. Results A total of 996 patients were included in the study. Most of the patients (86%) received general anesthesia and 73.9% of them had a history of previous operation. Younger patients (<40 years) (P=0.042) and those took regular benzodiazepine at bedtime (P=0.043) anticipated significantly higher pain levels. Male patients anticipated significantly lower pain intensities than females (odd ratio 1.710; 95% CI 1.254-2.331, P=0.001). Patients who scheduled for laparotomies (P=0.037), orthopedic surgeries (P=0.040) or long procedures (P<0.001) reported higher anticipated pain. Although higher anticipated pain scores were associated with higher postoperative pain levels (P=0.021) and higher total equivalent opioid dose (P=0.001) for acute pain management during the perioperative period, these surgical patients actually experienced less pain than they anticipated at the post-anesthesia care unit. Conclusion This observational study found that patients who are female, younger age (<40 years), use regular benzodiazepines at bedtime and scheduled for long procedures (>2 h), laparotomies or orthopedic surgeries anticipate significantly higher surgery-related pain. Therefore, appropriate preoperative counseling for analgesic control and the management of exaggerated pain expectation in these patients is necessary to improve the quality of anesthesia delivered and patient's satisfaction.

Background

Inadequate postoperative pain management can lead to physical and psychological distress in patients as well as impact surgical wound healing [1-5] and increase the risk of developing postoperative delirium [6] and cardiopulmonary and thromboembolic events [7]. Severe postoperative pain can also result in the development of chronic pain, which in turn can lead to prolonged opioids use and increased health-care costs [8]. Although numerous clinical pathways and strategies have been recently implemented, such as the introduction of the enhanced recovery after surgery (ERAS) program and multimodal analgesia (MMA), rates of inadequate postoperative pain management remain as high as 40-56.4% in the general surgical population [9-12]. and the prevalence rates of persistent pain after major operations can reach up to 50% [1].

Several perioperative factors such as age, catastrophizing pain scores, gender, psychological distress and operation type have been suggested to be closely associated with the postoperative pain intensity and analgesic usage [13-15]. The presence of preoperative depression has been shown to be associated with higher pain scale ratings and increased requirements for analgesics [16-19]. Preoperative expectations of pain can also affect the severity of postoperative pain [20-24]. However, very few large scale clinical studies have investigated the relationship between surgical patient's preoperative anticipated pain intensity and the actual pain intensity experienced after operations. Therefore, this clinical observational study aimed to determine the patient characteristics and perioperative factors influencing the subjective anticipated pain intensities in a general surgical population. The anticipated pain scales were also correlated with the actual pain intensity experienced and analgesic required by the patients after surgery.

Methods

Study population and study protocol

This prospective observational study was approved by the ethics committee and the institutional review board of E-Da Hospital, Taiwan (approval number EMRP107018). Consecutive patients who received elective surgery under general or regional anesthesia during June 2018 to August 2018 were included in this study and patients scheduled for emergency operations or those who required postoperative intensive care were excluded (Figure 1). Patients were invited to voluntarily respond to a quantitative question during their preoperative anesthesia assessment. The patients were asked to rate their highest subjective anticipated postoperative pain intensity (numeric rating scale (NRS) 0-10). After their operations, patients were admitted to the postoperative care unit (PACU). The nurse specialists in the PACU recorded the pain levels by asking the patient's subjective NRS (1-10) at 15-minute intervals. The total analgesic dosages administered in the operating room and in the PACU were also recorded. All anesthetic and surgical interventions administered in this study, including procedures and medications, followed standard clinical practice protocol or physician's decision. The equivalent doses of opioids used during the perioperative period was calculated according to the updated practical opioid rotation and equianalgesic tables [25]. A culturally relevant depression screening questionnaire, the Taiwanese Depression Questionnaire (TDQ), was used to assess for depression in patients who were admitted to the surgical wards [26]. This 18-item screening tool has a reported sensitivity of 0.89 and a specificity of 0.92 at a cutoff score of 19 for depression screening in the general Taiwanese public [26].

Statistics

An anticipated pain intensity (NRS) of $^{3}4$ during preoperative assessment was defined as a high pain level, and a pain intensity (NRS) $^{3}4$ measured at PACU was defined as high pain level that required analgesic intervention [7]. The associations between patients' anticipated pain intensity and their demographical data, anesthesia and surgical-related factors were analyzed. The values of continuous variables were compared using an independent two-sample t test, one-way ANOVA or Wilcoxon rank-sum test, as appropriate. Categorical variables were compared using chi-square or Fisher's exact test. A conditional logistic regression model was adopted to evaluate the factors of interest (patient demographic and clinical variables) and the preoperative anticipated pain scales. Statistical significance was accepted at a level of $P< 0.05$. All statistical analyses were performed using the SAS software, version 9.1 (SPSS software, version 24.0 (IBM, Armonk, NY).

Results

General outcomes

A total of 996 eligible patients were included in the study, as one patient was excluded due to incomplete data (Figure 1). The mean time interval between preoperative and postoperative pain assessment was 1.7±5.8 (range 0-108) days. The mean age of the study population was 50.9±15.6 years and 50.9% of the patients were male (Table 1). Most of these patients (86%) received general anesthesia for their procedures and 73.9% of them had at least one previous surgery (Table 1). Types of operation are listed in Table 1. The mean anticipated pain intensity (NRS) before surgery was 4.9±2.6 (range 0-10) and 71.1% of the patients anticipated to develop high pain intensity (NRS ³4) after their operations (Table 1).

Patient characteristics and preoperative self-anticipated pain

Female patients anticipated significantly higher pain levels than male patients with an adjusted odds ratio (AOR) of 1.978 (95% confidence interval (CI)1.492-2.622, P<0.001) (Table 2). Compared with younger patients, patients over 41 years of age were significantly less worried about postoperative pain (Table 2, P<0.001). Patients with a higher American Society of Anesthesiologists physical class (ASA PC ³III) and a history of previous operations were associated with a lower anticipated pain intensity (Table 2). Patients who were taking regular benzodiazepines at bedtime reported significantly higher anticipated pain levels (AOR 1.614, 95% CI 1.023-2.546, P=0.039). Education level and depression did not affect anticipated pain scores (Table 2).

Surgical factors and preoperative self-anticipated pain

Compared with laparoscopic surgeries, patients scheduled for laparotomic surgeries reported significantly higher anticipated pain intensities (AOR 2.836, 95% CI 1.198-6.712, P=0.018). Patients scheduled for uroscopies and hysteroscopic procedures anticipated significantly lower pain intensities (AOR 0.528, 95% CI 0.333-0.839, P=0.07) (Table 3). Patients scheduled for longer procedures were found to predict significantly higher anticipated pain intensities compared with those scheduled for shorter surgery time (<2h) (Table 3). Procedures performed under regional anesthesia (neuraxial or peripheral nerve blocks) significantly reduced patients' anticipated pain scale compared to general anesthesia (AOR 0.674; 95% CI 0.462-0.983, P=0.04) (Table 3).

Association between preoperative anticipated pain and postoperative pain

The NRS recorded by PACU nurses showed that 58.1% of patients had adequate pain control (highest NRS£ 3) within one hour after surgery (Table 4). Before surgery, 41.6% and 24.3% of patients anticipated moderate (4-6) and high (³ 7) pain intensity, respectively (Table 4). However, only 1.0% of patients actually experienced high pain intensities (highest NRS³ 7) in PACU, and 40.8% of patients experienced moderate surgical pain in PACU (highest NRS 4-6) (Table 4). Equivalent opioid doses administered during surgery and at PACU was used as an alternative indicator of postoperative pain level. Patients who anticipated higher pain intensity before surgery received significantly higher total equivalent opioid doses during surgery and in PACU (P=0.001) (Table 5).

Conditional logistic regression analysis of perioperative factors for preoperative anticipated pain intensity

Following a conditional multivariate logistic regression analysis, female gender was associated with significantly higher anticipated pain intensity, and older age (>40 years) was associated with lower anticipated pain intensity with odds ratios of 1.710 (95% CI 1.254-2.331, P=0.001) and 0.670 (95% CI 0.456-0.986, P=0.042) respectively (Table 6). Furthermore, patients who took regular benzodiazepines at bedtime reported significantly higher anticipated pain intensities (AOR 1.651; 95% CI 1.015-2.687, P=0.043) (Table 6). Patients scheduled to receive laparotomies or orthopedic surgeries were associated with higher anticipated pain score with an odds ratios of 2.591 (95% CI 1.061-6.330, P=0.037) and 1.724 (95% CI 1.025-2.898, P=0.040), respectively (Table 6). Prolonged operation times (>2h) were also an independent risk factor for increased anticipated pain intensity in general surgical patients (Table 6).

Discussion

A major limitations in postoperative pain management has been the fact that a patient's personal perception of pain may not always be taken into account during preoperative pain counseling. Acute postoperative pain is a subjective and multidimensional experience that is extremely hard to measure and manage optimally. The results of this study demonstrated that female patients, younger patients, patients took regular benzodiazepine at bedtime, and patients scheduled for laparotomic/orthopedic surgery or long procedures are especially concerned about inadequate pain control after surgery.

Gender is commonly considered as a strong predictor for pain perception and analgesic requirements after surgery [27 ,28]. However, some systematic reviews have not found gender to be an independent predictor for postoperative pain levels or analgesic requirements [15]. The results of our survey suggest that female patients anticipated significantly higher pain levels preoperatively than male patients, the difference remained statistically significant following a multivariate regression analysis with an odds ratio of 1.710 (95% CI 1.254-2.331). These results support the findings of numerous previous studies [29-31]. Our study also indicated that older patients (>40 years) anticipated a lesser degree of surgery-related pain during their preoperative assessments as compared to those who were younger. We suggest that this observation may be due to the elderly being associated with less preoperative anxiety and that they do not request for as much information concerning their operations [32-34]. Our results are also consistent with a previous prospective observational study which showed that older patients reported lower anxiety scores and expected pain scores before operations [35]. Since a history of previous surgery is usually associated with decreased preoperative anxiety [36 ,37], it was not surprising to find that previous surgery had a diminishing effect on preoperative anticipated pain levels.

Previous studies have suggested that patients with psychosomatic and behavioral disorders (*e.g.* major depression, insomnia, and catastrophizing pain) can have a decreased tolerances for postoperative pain [18, 38-40]. Our study has found that regular benzodiazepine use at bedtime is an independent risk factor for high anticipated postoperative pain intensity during preoperative assessments. However, no differences were found in preoperative pain anticipation between surgical patients with and without depression.

Several perioperative factors were surveyed for their effects on anticipated pain levels. Consistent with other clinical studies, our analysis identified that patients scheduled for laparotomies, spinal, and orthopedic surgeries anticipated higher pain scores than those receiving laparoscopic procedures [41-43]. On the other hand, patients receiving uroscopies and hysteroscopies anticipated less surgical pain. Compared with general anesthesia, univariate analysis showed that regional blocks significantly reduced patient concerns regarding postoperative pain. Prolonged operation times was also an independent risk factor for increased anticipated pain. These findings support the general concept that the invasiveness and duration of an operation can affect patients' anticipated perception of surgical-related pain in the preoperative period [15]. Nevertheless, this study did not find significant effects of other patient characteristic variables, such as educational levels, marital and socioeconomic status on the anticipation of surgical pain intensity.

Preoperative anticipated pain intensity was compared with the highest postoperative pain intensity recorded in PACU, and the total equivalent dose of opioids prescribed perioperatively. Our analysis found that patients anticipated significantly more pain preoperatively than they actually experienced after surgery. This was particularly evident in patients who anticipated severe pain (NRS^3 7) preoperatively, these patients were actually more likely to report a lower pain intensity in PACU. Although there was a positive relationship between preoperative anticipated pain intensity and perioperative total equivalent dose of opioid administered (during surgery and in PACU), the correlation coefficient was extremely low. These observations suggest that patients tend to overestimate surgery-related pain levels. However, anesthesiologists are still more likely to prescribe postoperative analgesics based on the type and duration of the operation rather than the patient's subjective perception of pain [43 ,44].

After extensively reviewing 48 studies, Ip *et al*. identified several independent perioperative factors for predicting actual levels of postoperative pain and analgesic usage [15]. These predictive factors include the presence of preoperative pain, anxiety, age, and type of surgery (*i.e.* major joint, thoracic, and open abdominal surgery) and are associated with higher postoperative pain scores. Surgery type, age, and psychological distress were found to be significant predictors of analgesic usage. Ip and colleagues' systematic review found that gender had a neutral effect on postoperative pain levels and analgesic requirements, but the results of our study indicated that females anticipated more postoperative pain preoperatively. This major discrepancy could be due to the general understanding that female patients can react more emotionally to physical distress, but the distress is no less authentic and they are not less ill than the male patients [45-47].

The results of this study must be interpreted in light of several limitations. Firstly, patients were invited to voluntarily rate the anticipated pain intensity during their preoperative anesthesia assessment. Therefore, the knowledge and motives of the individual patient might impact the response to the quantitative question. Secondly, patients' preoperative psychological conditions are routinely assessed using a culturally relevant depression screening questionnaire, the Taiwanese Depression Questionnaire (TDQ) in our hospital. This short questionnaire were designed to be simple and practical so that it could be applied to the general population in a time-efficient manner. The comprehensive versions for diagnosing depression and chronic insomnia were not used in this study. Therefore, this study may have been underpowered to isolate depression as an independent risk factor for the anticipation of severe postoperative pain. Lastly, our results were not generalized to critically ill patients who were scheduled for postoperative intensive care or emergent surgery.

Conclusions

Our study demonstrated that female gender, younger age (< 40 years), regular benzodiazepine use at bedtime, prolonged operation times (> 2 h), and operation type (*e.g.* laparotomy and orthopedic surgery) are the significant risk factors for the anticipation of more severe pain before surgery. Therefore, these patients may require additional assessments and pain management counseling during their pre-anesthesia consultation. Appropriate preoperative counseling for analgesic control (especially the introduction of multimodal analgesia) and the management of unnecessary anticipated pain levels could improve the quality of anesthesia delivery and patient perioperative satisfaction.

Abbreviations

AOR: adjusted odds ratio; ASA PS: American Society for Anesthesiologist physical statuses; BMI: body mass index; CI: confidence interval; ERAS: enhanced recovery after surgery; MMA: multimodal analgesia; NRS: numeric rating scale; PACU: postanesthesia care unit; TDQ: the Taiwanese Depression Questionnaire; VAS: visual analogue scale

Declarations

Ethics approval and consent to participate: The study protocol was approved by the institutional review board of the E-Da Hospital, Kaohsiung, Taiwan (EMRP107018). Written informed consents were obtained from the patients or their legal representatives.

Consent for publication: not applicable

Availability of data and material: The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

Competing interests: The authors declare that they have no competing interests.

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Authors' contributions: WSC, SCC, CFL and YCT designed the study. WSC, YTH, MCC, and YCC collected the questionnaires and data acquisition. WSC, TSC, CFL and YCT contributed to the statistical analysis and interpretation of data. WSC, YTH, MCC, CFL and YCT contributed to drafting the manuscript. All authors read and approved the final version of manuscript. CFL and YCT contributed equally to the work.

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Tables

Table 1. Patient demographical data (n=996)

Characteristics	n (%) or mean±SD
Age (years, mean)	50.9±15.6
Age groups (years)	
<40	262 (26.3%)
40~60	438 (44%)
60~80	271 (27.2%)
>80	25 (2.5%)
Gender	
Male	507 (50.9%)
Female	489 (49.1%)
Body height (cm)	162.1±11.3
Body weight (kg)	68.6±16.4
Body mass index (kg/cm^2)	
<24.5	441 (44.3%)
>=24.5	555 (55.7%)
Educational levels	
Illiteracy	41 (4.1%)
< College or high school	634 (63.7%)
≥ University	321 (32.2%)
Depression (yes)	105 (10.5%)
Surgical history (yes)	736 (73.9%)
Mean anticipating NRS	4.9±2.6
Anticipating severe pain (NRS ≥4)	708 (71.7%)
Types of anesthesia	
General anesthesia	857(86.0%)
Regional anesthesia	139(14.0%)
ASA physical status	
I-II	831(83.4%)
III-V	165(16.6%)
Types of operation	
Laparoscopic surgery	163 (16.4%)
Spine surgery	133 (13.4%)
Breast and plastic surgery	85 (8.5%)
orthopedic surgery	179 (18.0%)
Laparotomy surgery	56 (5.6%)
Head-and-neck and dental surgery	157 (15.8%)
Uroscopy and hysteroscopy	159 (16.0%)
Other surgery	64 (6.4%)

NRS: numerical rating scale

Table.2 Patient's predicting factors for inadequate pain control after operation (preoperative anticipating pain scale ≥4)

	AOR	95% CI	P value
Gender			
Male	Ref		
Female	1.978	1.492-2.622	0.001
Age (years)			
0-40	Ref		
41-60	0.609	0.425-0.874	0.007
> 61	0.542	0.369-0.796	0.002
Prior surgical history			
No	Ref		
Yes	0.823	0.598-1.134	0.233
Regular benzodiazepine use at bedtime			
No	Ref		
Yes	1.614	1.023-2.546	0.039
Depression*			
No	Ref		
Yes	1.016	0.990-1.042	0.228
Educational levels			
Illiteracy	Ref		
< College or high school	1.074	0.545-2.119	0.836
≥ University	1.376	0.680-2.782	0.375
ASA physical status			
I-II	Ref		
III-V	0.742	0.519-1.059	0.100

*Depression was assessed using a culturally relevant depression screening questionnaire, the Taiwanese Depression Questionnaire (TDQ)

Table.3 Surgical and anesthesia predicting factors for inadequate pain control after operation (preoperative anticipating pain scale □4)

	AOR	95% CI	P value
Types of surgery			
Laparoscopic surgery	Ref		
Spine surgery	1.266	0.751-2.136	0.376
Breast and plastic surgery	1.030	0.576-1.842	0.921
Orthopedic surgery	1.322	0.814-2.145	0.259
Laparotomy surgery	2.836	1.198-6.712	0.018
Head-and-neck and dental surgery	0.920	0.569-1.486	0.734
Uroscopy and hysteroscopy	0.528	0.333-0.839	0.007
Other surgery	1.216	0.629-2.351	0.562
Operation time (h)			
£ 2	Ref		
2-4	1.888	1.401-2.545	0.001
> 4	1.935	1.249-2.997	0.040
Types of anesthesia			
General anesthesia	Ref		
Regional anesthesia	0.674	0.462-0.983	0.040

Table 4. Comparison between patient's preoperative self-anticipating pain and postoperative pain score measured in PACU

	Preoperative self-anticipating pain score			P value
Highest pain score at PACU	NRS £3	NRS 4-6	NRS 7-10	=0.021
NRS £3	184 (18.6%)	260 (26.3%)	130 (13.2%)	574(58.2%)
NRS 4-6	97 (10.0%)	201 (20.4%)	105 (10.6%)	403(40.8%)
NRS 7-10	1 (0.1%)	4 (0.4%)	5 (0.5%)	10(1.0%)
Total patients (n=987)*	282(28.6%)	411(41.6%)	240(24.3%)	

NRS: numerical rating scale; PACU: post-anesthesia care unit. *A total of 987 datasets were analyzed due to missing of the NRS in the PACU

Table 5. Comparison between patient's preoperative self-anticipating pain and total equivalent opioid dose administered during perioperative period (n=996)

	Preoperative self-anticipating pain score			P value
	NRS £3	NRS 4-6	NRS 7-10	
Equivalent dose of opioid (mg) in OR	10.5±7.0	12.0±8.0	12.3±8.0	0.012
Equivalent dose of opioid (mg) at PACU	2.3±3.0	3.0±3.5	3.3±7.1	0.023
Equivalent dose of opioid (mg) during perioperative period	12.8±8.2	15.0±9.2	15.3±9.1	0.001

NRS: numerical rating scale; OR: operating room, PACU: post-anesthesia care unit.

Table 6. multiple variation analysis for patient demographic, surgical and anesthesia predicting factors for inadequate pain control after operation (preoperative anticipating pain scale NRS □4)

	AOR	95% CI	P value
Gender			
Male	Ref		
Female	1.710	1.254-2.331	0.001
Age (years)			
0-40	Ref		
>40	0.670	0.456-0.986	0.042
Prior surgical history			
No	Ref		
Yes	0.813	0.575-1.149	0.240
Regular use of benzodiazepines at bedtime			
No	Ref		
Yes	1.651	1.015-2.687	0.043
Depression			
No	Ref		
Yes	1.016	0.988-1.045	0.256
Educational levels			
Illiteracy	Ref		
< College or high school	1.268	0.607-2.651	0.528
□ University	1.441	0.652-3.182	0.367
ASA physical class			
I-II	Ref		
III-V	0.804	0.543-1.190	0.276
Types of surgery			
Laparoscopic surgery	Ref		
Spine surgery	1.319	0.749-2.322	0.338
Breast and plastic surgery	1.274	0.689-2.355	0.441
Orthopedic surgery	1.724	1.025-2.898	0.040
Laparotomy surgery	2.591	1.061-6.330	0.037
Head-and-neck and dental surgery	1.135	0.683-1.887	0.624
Uroscopy and hysteroscopy	0.850	0.505-1.431	0.541
Other surgery	1.952	0.947-4.023	0.070
Operation time (h)			
£ 2			

	Ref		
2-4	1.795	1.299-2.482	0.001
> 4	1.870	1.145-3.053	0.012
Types of anesthesia			
General anesthesia	Ref		
Regional anesthesia	0.827	0.523-1.305	0.414

Figures

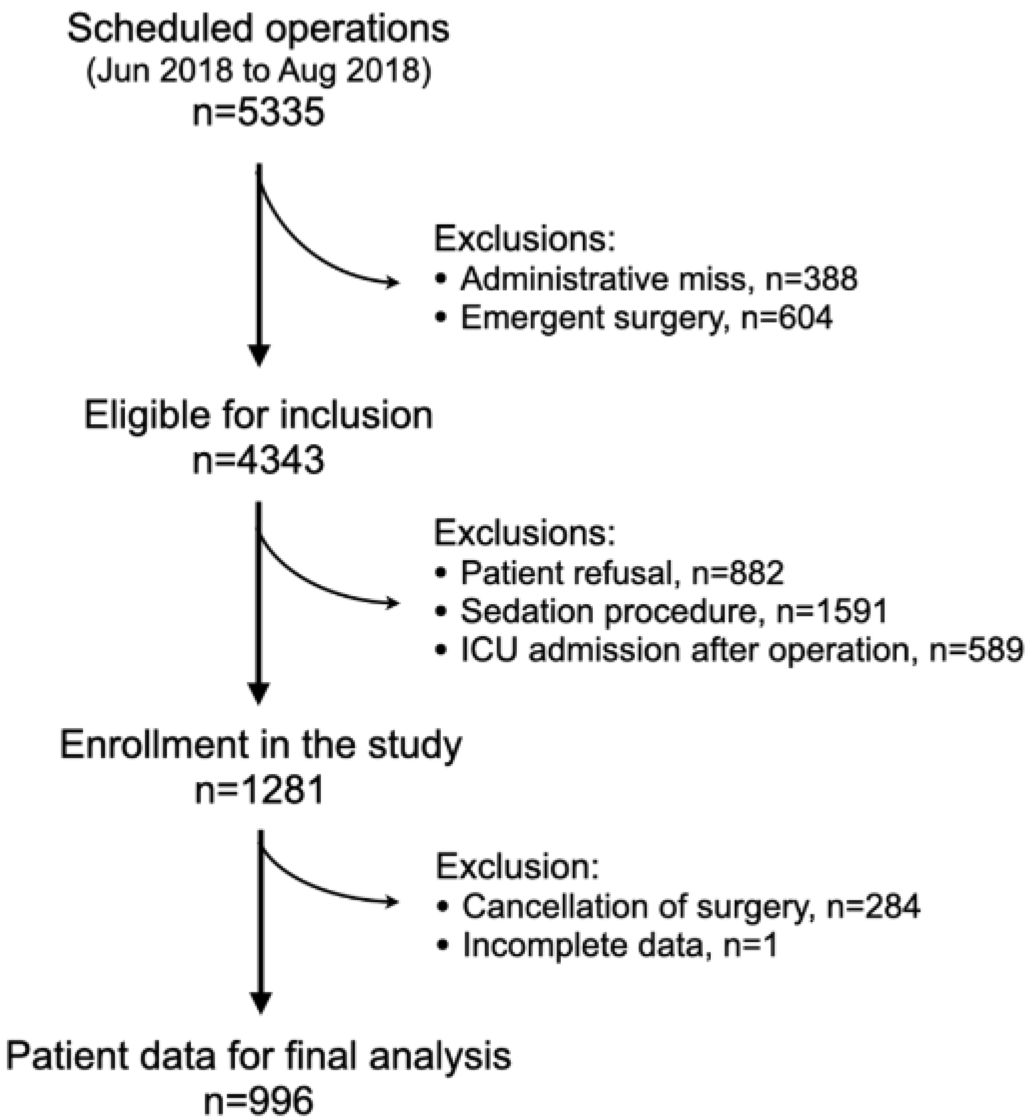

Figure 1

Study flow diagram.

Supplementary Files

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- Supplementarytable1.docx