Perioperative analgesic requirements in severely obese adolescents and young adults undergoing laparoscopic versus robotic-assisted gastric sleeve resection

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ABSTRACT

Purpose: One of the major advantages for patients undergoing minimally invasive surgery as compared to an open surgical procedure is the improved recovery profile and decreased opioid requirements in the perioperative period. There are no definitive studies comparing the analgesic requirements in patients undergoing two different types of minimally invasive procedure. This study retrospectively compares the perioperative analgesic requirements in severely obese adolescents and young adults undergoing laparoscopic versus robotic-assisted laparoscopic gastric sleeve resection.

Materials and Methods: With Institutional Review Board approval, the medication administration records of all severely obese patients who underwent gastric sleeve resection were retrospectively reviewed. Intra-operative analgesic and adjuvant medications administered, postoperative analgesic requirements, and visual analog pain scores were compared between those undergoing a laparoscopic procedure versus a robotic-assisted procedure.

Results: This study cohort included a total of 28 patients who underwent gastric sleeve resection surgery with 14 patients in the laparoscopic group and 14 patients in the robotic-assisted group. Intra-operative adjuvant administration of both intravenous acetaminophen and ketorolac was similar in both groups. Patients in the robotic-assisted group required significantly less opioid during the intra-operative period as compared to patients in the laparoscopic group (0.15 ± 0.08 mg/kg vs. 0.19 ± 0.06 mg/kg morphine, P = 0.024). Cumulative opioid requirements for the first 72 postoperative h were similar in both the groups (0.64 ± 0.25 vs. 0.68 ± 0.27 mg/kg morphine, P = NS). No difference was noted in the postoperative pain scores.

Conclusion: Although intraoperative opioid administration was lower in the robotic-assisted group, the postoperative opioid requirements, and the postoperative pain scores were similar in both groups.

Key words: Bariatric surgery, perioperative analgesic requirements, robotic surgery

INTRODUCTION

The major demonstrated advantages of minimally invasive surgical procedures when compared with open surgery includes better cosmetic results, shorter hospital stay, and decreased postoperative pain resulting in decreased analgesic use.¹,² Comparison of the analgesic requirements following traditional laparoscopic and robotic-assisted laparoscopic surgeries in the adult population has demonstrated decreased opioid requirements in the robotic-assisted group.³ However, there are no definitive studies in the adolescent population comparing the analgesic requirements in patients undergoing two different types of minimally invasive surgery. The purpose of this study was to retrospectively compare the perioperative analgesic requirements in severely obese adolescents undergoing laparoscopic and robotic-assisted laparoscopic gastric sleeve resection.
MATERIALS AND METHODS

Following Institutional Review Board approval, a retrospective review of all severely obese patients, who underwent gastric sleeve resection surgery at Nationwide Children's Hospital (Columbus, Ohio, USA) from June 2012 to August 2013 was performed. The medication administration records were reviewed for each patient and the intraoperative analgesic medication including the adjuvant analgesic agents administered, postoperative analgesic requirements for 72 h, and visual analog pain scores were recorded. Intra-operatively, anesthesis was induced with propofol followed by maintenance anesthesis with remifentanil infusion and a volatile anesthetic agent (desflurane or sevoflurane) titrated according to bispectral index monitoring. Neuromuscular blockade was provided by intermittent doses of rocuronium. The insufflation pressures during pneumoperitoneum in both the groups were identical with gas flow at 8 L/min and intra-abdominal pressure limited to <18 mmHg. At the completion of the surgical procedure, the port sites were infiltrated with a local anesthetic agent (0.25% bupivacaine). Postoperatively per our standard practice was the administration of opioids with a patient-controlled analgesic (PCA) pump. The PCA included a basal infusion for the first 24 postoperative hours after which the patients were started on oral pain medications, which was supplemented with bolus doses from the PCA without a basal infusion. The opioid used in the PCA and the initial settings were at the discretion of the attending anesthesiologist. For the purpose of comparison, all intravenous opioid doses were converted to morphine equivalent doses based on standard conversions. The total number of doses of adjuvant analgesic medications including either intravenous acetaminophen or ketorolac administered in the postoperative period was also recorded.

At our institution, the severity of the pain is assessed as a part of routine postoperative vital sign monitoring for all surgical patients. Pain is rated using the visual analog scale with 0 = no pain and 10 = worst imaginable pain. The first pain score was collected on arrival to the postanesthesia care unit (PACU) and a second score at the time of discharge from the PACU to the floor. The pain scores were further documented every 4 h while on the inpatient ward. An average pain score was calculated for each patient during the postoperative period.

Categorical data were compared between the groups by using likelihood ratio Chi-square test or Fisher's exact test as appropriate. Continuous data were compared using nonparametric Wilcoxon two-sample test. The data are listed as the mean ± standard deviation with $P < 0.05$ considered significant. All tests were conducted in SAS 9.3 (by SAS Institute Inc., Cary, NC, USA).

RESULTS

The study cohort included 28 adolescent patients, who underwent gastric sleeve resection surgery for the treatment of obesity from June 2012 to August 2013. Fourteen procedures were performed using a conventional laparoscopic approach and 14 by a robotic-assisted laparoscopic approach. The demographic characteristics of the patients are listed in Table 1. Comparison between the groups showed no difference in age, weight, gender, or body mass index. When comparing the operative times, patients in the robotic group had significantly longer operative times (136 ± 27.6 min, median = 131.5 min) as compared to patients in the laparoscopic group (99.3 ± 13.3 min, median = 99.5 min, $P = 0.0002$).

Patients in the robotic-assisted group required significantly less opioid during the intra-operative period than patients in the laparoscopic group (0.15 ± 0.08 vs. 0.19 ± 0.06 mg/kg morphine, $P = 0.024$). The opioid requirement in the recovery room (0.03 ± 0.015 mg/kg in laparoscopic vs. 0.02 ± 0.012 in the robotic group, $P = 0.723$) and the cumulative opioid requirement for the first 72 postoperative h was similar in both groups (0.64 ± 0.25 mg/kg in the laparoscopic group vs. 0.68 ± 0.27 mg/kg) in the robotic-assisted group, $P = 0.782$ [Table 2]. The intra-operative adjuvant administration of either intravenous acetaminophen or ketorolac was similar in both groups [Table 2]. In the postoperative period, 20 patients received adjuvant analgesic agents (11 patients in the robotic-assisted group and 9 in the laparoscopic group). The PCA discontinuation time was also similar in both the groups (35.3 ± 14.5 h in the laparoscopic group versus 41.4 ± 11.9 h in the robotic group, $P = 0.277$).

The postoperative pain scores were significantly lower at discharge from PACU in the robotic group as compared to the laparoscopic group (2.3 ± 2.7 vs. 4.9 ± 2.4, $P = 0.014$). However, there was no difference in the mean cumulative 72 h pain score during the postoperative period (3.7 ± 1.3 in the laparoscopic group vs. 3.0 ± 0.9 in the robotic-assisted group, $P = 0.26$) [Table 3].

| Table 1: Demographic data of the study cohort |
|-----------------------------------------------|
| Variable | Laparoscopic ($n = 14$) | Robotic-assisted ($n = 14$) | $P$ |
|----------|------------------------|--------------------------|-----|
| BMI (kg/m$^2$) | 48.31 (4.56) | 46.34 (6.97) | 0.2064 |
| Weight (kg) | 333.07 (27.50) | 327.74 (17.34) | 0.569 |
| Age (years) | 17.93 (1.49) | 16.86 (2.03) | 0.1229 |
| Male to female | 3:11 | 4:10 | 0.6483 |

*Data are listed as the mean with (SD). SD: Standard deviation; BMI: Body mass index.
DISCUSSION

This retrospective study was conducted to compare the analgesic requirements in the perioperative period for patients undergoing bariatric surgery (gastric sleeve resection) by two different minimally invasive procedures. Several factors may be responsible for pain following minimally invasive procedures using abdominal insufflation with carbon dioxide including the temperature of the gas that is used, humidification, insufflating pressures, duration of the pneumoperitoneum, and the amount of residual carbon dioxide that is left following the procedure. While alterations in the surgical technique (laparoscopic vs. robotic-assisted) may also play a role in the genesis of postoperative pain, it is incumbent on the surgeon and anesthesiologist to control the intra-operative events which may impact perioperative pain. As such, close communication to limit insufflation pressures as feasible and total evacuation of residual carbon dioxide at the completion of the surgical procedure are mandatory to limit perioperative pain. As all of the surgical procedures were completed by a single team of surgeons and anesthesia procedures, the perioperative course, and anesthetic care were similar between these two cohorts thereby allowing us to compare the potential impact of the surgical technique.

Although we noted, a decrease in the intraoperative opioid requirements in patients undergoing a robotic-assisted procedure, this difference was not maintained when comparing the cumulative opioid needs during the entire 72 h perioperative period (intra-operative and postoperative period). These findings are different from those reported by Soliman et al. who compared the analgesic and antiemetic requirements for patients undergoing surgery for early cervical cancer using a laparoscopic or robotic approach. They noted that the total intravenous opioid requirements were significantly higher in the laparoscopic group as compared to the patients in the robotic group.[3]

Previous studies in the adult population have demonstrated differences in opioid requirements based on variations in the surgical technique. In a prospective comparison, Chen et al. noted significantly less postoperative pain in the single port versus multiport laparoscopic procedures, manifested by lower visual analog scores, and lower opioid requirements.[4] Similar findings were reported by Fagotti et al. when comparing conventional multiport laparoscopy and single site surgery for benign adnexal disease.[5] These studies have demonstrated that even when using minimally invasive surgical techniques, variations of the surgical approach can impact the postoperative pain, and comfort for the patient.

Our preliminary study is one of the first to compare the perioperative opioid requirements in adolescents undergoing gastric sleeve resection surgery by two different minimally invasive surgical techniques. The patients in the robotic group had a decreased opioid requirement in the intraoperative period, even though, the operative times was significantly longer in the robotic group as compared to the laparoscopic group. However, this decreased opioid requirement did not translate into the postoperative period as no difference was found in the opioid requirements in the recovery room and during the postoperative period. Likewise, no difference was noted in the use of analgesic adjuncts including acetaminophen and ketorolac. Although pain scores were lower in the PACU in the robotic group, there was again no difference noted during the postoperative period.

### Table 2: Perioperative opioid and analgesic adjuvant administration

| Variables                      | Laparoscopic Mean (SD) | Robotic-assisted Mean (SD) | P |
|--------------------------------|------------------------|---------------------------|---|
| Intra-operative morphine (mg/kg)* | 0.19 (0.06)            | 0.15 (0.08)               | 0.024 |
| Intra-operative adjuvant used   |                        |                          |    |
| None                           | 3                      | 7                         | 0.236 |
| Acetaminophen                  | 10                     | 7                         |    |
| Ketorolac                      | 1                      | 0                         |    |
| PACU morphine (mg/kg)          | 0.03 (0.015)           | 0.02 (0.012)              | 0.723 |
| 72 h cumulative morphine (mg/kg)* | 0.64 (0.25)            | 0.68 (0.27)               | 0.782 |
| Number of patients requiring postoperative adjuvants (%) | 9 (64.3) | 11 (78.6) | 0.676 |
| Hours to discontinuation of PCA | 35.3 (14.5)            | 41.4 (11.9)               | 0.277 |

*Calculated as morphine equivalents. SD: Standard deviation; PACU: Postanesthesia care unit; PCA: Patient-controlled analgesic

### Table 3: Postoperative pain scores

| Time                     | Mean (SD) | Robotic-assisted Mean (SD) | P |
|--------------------------|-----------|---------------------------|---|
| PACU arrival             | 6.4 (3.1) | 7.6 (3.2)                 | 0.16 |
| PACU discharge           | 4.9 (2.4) | 2.3 (2.7)                 | 0.01 |
| Cumulative postoperative scores | 3.7 (1.3) | 3.0 (0.9)                 | 0.26 |
| Postoperative day 1      | 4.1 (2.2) | 2.9 (3.3)                 | 0.13 |
| Postoperative day 2      | 3.1 (1.9) | 3.2 (2.1)                 | 0.96 |
| Postoperative day 3      | 3.1 (1.7) | 3.3 (1.7)                 | 0.79 |

PACU: Postanesthesia care unit
Being a retrospective study, our methodology had a few limitations. The intra-operative anesthetics and opioid prescription was physician-based and patients were not treated according to a standard protocol. Patients in both the groups had a PCA with a background infusion for the postoperative period, but the adjuvant pain medications administered was according to the surgeon’s discretion. The pain scores collected retrospectively every 4 h did not indicate whether the score was taken before or after the administration of the analgesic medication. A prospective study with a standardized intra-operative anesthetic and perioperative pain management for both the robotic and laparoscopic groups is required to further validate the perioperative opioid requirements and pain scores in this unique surgical population.

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