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## Open vs laparoscopic inguinal hernia repair: Influences of patient age and bmi on analgesic requirements and hospital stay duration

### Abstract

**Aim:** Comparisons between open vs laparoscopic surgical methods for inguinal hernia repair have yielded inconsistent results with respect to patients' pain levels and analgesic requirements post-surgery. This study compared open vs laparoscopic inguinal hernia repair in terms of types and quantity of analgesics administered during the postoperative recovery period and the hospital stay, including the influences of patient characteristics such as age, BMI, and previous inguinal hernia repair. **Materials and methods:** This was a cross-sectional study of retrospective analysis of data pertaining to inguinal hernia repairs in a rural hospital in Australia. **Results:** Among 63 patients (60 males), 62% had undergone open and 38% laparoscopic surgery for inguinal hernia repair. Type and dose of analgesic medications given during both the postoperative recovery period and the hospital ward stay and the duration of the hospital stay were not significantly different between open and laparoscopic groups. However, there were significant influences of BMI, with significantly more overweight and obese patients requiring a combination of opioids with nonsteroidal anti-inflammatory drug (NSAID) or paracetamol during the hospital stay, and with obese patients having the longest hospital stay, followed by overweight patients. Patients who had open surgery were significantly older and less likely to have had a previous inguinal hernia repair than those who had laparoscopic surgery, and there was a significant correlation between age and duration of hospital stay. **Conclusion:** Patient characteristics of age, BMI, and previous inguinal hernia repair are confounding factors when comparing analgesic requirements and hospital stay duration after open vs laparoscopic inguinal hernia repair.

### Publication Details

Mwagiru, D. & Larkin, T. (2020). Open vs laparoscopic inguinal hernia repair: Influences of patient age and bmi on analgesic requirements and hospital stay duration. *World Journal of Laparoscopic Surgery*, 13 (1), 26-30.

# Open vs Laparoscopic Inguinal Hernia Repair: Influences of Patient Age and BMI on Analgesic Requirements and Hospital Stay Duration

Derek K Mwangiru<sup>1</sup>, Theresa A Larkin<sup>2</sup>

## ABSTRACT

**Aim:** Comparisons between open vs laparoscopic surgical methods for inguinal hernia repair have yielded inconsistent results with respect to patients' pain levels and analgesic requirements post-surgery. This study compared open vs laparoscopic inguinal hernia repair in terms of types and quantity of analgesics administered during the postoperative recovery period and the hospital stay, including the influences of patient characteristics such as age, BMI, and previous inguinal hernia repair.

**Materials and methods:** This was a cross-sectional study of retrospective analysis of data pertaining to inguinal hernia repairs in a rural hospital in Australia.

**Results:** Among 63 patients (60 males), 62% had undergone open and 38% laparoscopic surgery for inguinal hernia repair. Type and dose of analgesic medications given during both the postoperative recovery period and the hospital ward stay and the duration of the hospital stay were not significantly different between open and laparoscopic groups. However, there were significant influences of BMI, with significantly more overweight and obese patients requiring a combination of opioids with nonsteroidal anti-inflammatory drug (NSAID) or paracetamol during the hospital stay, and with obese patients having the longest hospital stay, followed by overweight patients. Patients who had open surgery were significantly older and less likely to have had a previous inguinal hernia repair than those who had laparoscopic surgery, and there was a significant correlation between age and duration of hospital stay.

**Conclusion:** Patient characteristics of age, BMI, and previous inguinal hernia repair are confounding factors when comparing analgesic requirements and hospital stay duration after open vs laparoscopic inguinal hernia repair.

**Keywords:** Analgesic, BMI, Inguinal hernia, Laparoscopic.

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## INTRODUCTION

Inguinal hernias are one of the most common abdominal pathologies requiring surgery,<sup>1</sup> with the lifetime risks of developing an inguinal hernia estimated to be 27% for men and 3% for women.<sup>2</sup> An indirect inguinal hernia passes through the inguinal canal, while a direct inguinal hernia protrudes through the abdominal wall in the area of Hesselbach's triangle.<sup>3,4</sup> Both types of hernias can arise due to either congenital or acquired weakness of the abdominal wall and/or inguinal canal structures.

Current methods of inguinal hernia repair include either an open or a laparoscopic surgical approach, with the overall success based primarily on the fewest complications and the earliest return to normal activities.<sup>5</sup> Open hernia repairs involve an incision through the skin, fascia, and muscle of the abdominal wall to expose and reduce the hernia.<sup>6</sup> In contrast, the laparoscopic method is minimally invasive and does not require the division of muscle.<sup>7</sup> Despite laparoscopic surgery being technically more complex, which necessitates a longer duration of general anesthesia,<sup>7,8</sup> it is usually associated with a shorter recovery time compared with open surgery.<sup>9-12</sup>

Recently, there has been increased focus on postoperative and chronic pain as measures of surgical success.<sup>10</sup> Several studies have reported chronic pain rates of up to 20% after inguinal hernia repair.<sup>13-17</sup> Of significance is that in addition to postoperative pain itself being a measure of surgery recovery, untreated postoperative pain is a risk factor for chronic pain.<sup>13</sup> Assessment of postoperative pain after inguinal hernia repair using visual analog scores (VAS)

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is inconclusive,<sup>5,12,18</sup> however, as a subjective measure of pain this is limited. Other studies have compared analgesic consumption following inguinal hernia repair and reported this was lower after laparoscopic than open surgery, during the first day<sup>5,10,11,14,19</sup> and the first 7 days after surgery,<sup>12,20,21</sup> or not different between the two surgical modes.<sup>22</sup> However, most of these studies only assessed patients' intake of diclofenac and paracetamol, and did not consider any of the opioid-based analgesic medications administered during the immediate postoperative period or the hospital ward stay.

Patient characteristics can also influence analgesic medication intake. There are several predictors of chronic pain including younger age, higher BMI, and being discharged on the day of surgery rather than staying overnight;<sup>15,23</sup> however, the associations between these variables and postoperative pain have not been

reported with respect to inguinal hernia repair. In particular, while obesity affects drug volume distribution and modifies anesthetic requirements during surgery,<sup>24</sup> little research has examined the influence of BMI on postoperative analgesic use. Considering that increased body weight is an independent risk factor for developing an inguinal hernia, this is an important factor to assess in this context.

A comprehensive examination of postoperative analgesia consumption after open vs laparoscopic inguinal hernia repair in Australia is lacking. The current study aims to compare open vs laparoscopic surgical methods for inguinal hernia repairs in terms of the types and quantity of analgesia administered during the immediate postoperative recovery period (up to 1 hour post-surgery) and for the duration of the patient's hospital ward stay. In addition, patient characteristics of sex, age, weight, BMI, type of inguinal hernia, and previous inguinal hernia repair were included in analyzes for further comparison between open and laparoscopic groups, and associations between subgroups.

## MATERIALS AND METHODS

The project was undertaken after approval by the Human Research Ethics Committee of the University of Wollongong (LNR/16/WGONG/253). Patient data were obtained from Griffith Base Hospital, a 114-bed regional hospital in New South Wales, Australia, for all patients aged at least 18 years who had undergone an inguinal hernia repair during 2016–2017, using the hospital database (SurgiNet). All records were deidentified and only anonymous data were analyzed. Data collected included sex, age, weight, BMI, type of inguinal hernia (direct or indirect), whether there had been a previous inguinal hernia repair, the surgical repair method (open or laparoscopic), and duration of hospital stay. Details pertaining to analgesic medications given during recovery and while on the hospital ward were obtained from the respective medication charts. The type(s) of medication and dosage (concentration and frequency) were recorded, and total dose after surgery was calculated: (i) during recovery and (ii) during the hospital stay. To compare between doses of different opioid medications, an equivalent morphine dose was calculated, where 1 mg morphine = 1 mg oxycodone = 10 µg fentanyl.

Data were analyzed using IBM SPSS Statistics 21. Results are reported as means with standard deviations. Data between groups (open vs laparoscopic surgery) were compared using Student's unpaired *t* tests. Patients' BMIs were classified<sup>25</sup> as healthy (BMI = 18.5–24.9 kg/m<sup>2</sup>), overweight (BMI = 25–30 kg/m<sup>2</sup>), or obese (BMI > 30 kg/m<sup>2</sup>). The distributions of previous hernia, hernia type, and type of analgesia medication (for the recovery and hospital stay periods) were compared between surgery modes and BMI categories using Chi-square tests. One-way ANOVA was used to compare analgesic doses per BMI category.

## RESULTS

### Demographic and Anthropometric Data

Data from a total of 63 patients (60 males and 3 females) were included in the study. Demographic and anthropometric data are presented in Table 1. The majority of patients, including all three females, had undergone open surgery. There was a distinct difference in surgical mode for those younger vs older than 50 years of age: 76% of patients aged between 20 years and 49 years had

**Table 1:** Demographic and anthropometric data for patients who underwent open and laparoscopic surgery methods of inguinal hernia repair. Mean ± standard deviation with range in parentheses

|                                    | Open surgery<br>(n = 39; 62%) | Laparoscopic<br>surgery (n = 24;<br>38%) | Between-<br>group<br>comparison      |
|------------------------------------|-------------------------------|------------------------------------------|--------------------------------------|
| Age (years)                        | 66 ± 16 (22–88)               | 47 ± 16 (20–83)                          | <i>p</i> < 0.0001                    |
| Weight (kg)                        | 79 ± 13<br>(53–110)           | 84 ± 15<br>(78–112)                      | <i>p</i> = 0.126                     |
| BMI (kg/m <sup>2</sup> )           | 27 ± 3 (18–37)                | 28 ± 4 (20–37)                           | <i>p</i> = 0.274                     |
| Hernia type:<br>direct vs indirect | 41% vs 59%                    | 46% vs 54%                               | $\chi^2$ = 0.140<br><i>p</i> = 0.708 |
| Previous hernia                    | 21%                           | 58%                                      | $\chi^2$ = 9.351<br><i>p</i> = 0.002 |

undergone laparoscopic surgery while 81% of those aged between 50 years and 88 years had open surgery.

### Hernia Type and Previous Hernia

The majority (64%) of those with a previous hernia underwent laparoscopic surgery, while the majority (76%) of those for whom this was their first hernia repair had open surgery. A significantly higher proportion of patients with a direct hernia compared with an indirect hernia had a previous hernia (68% vs 29%;  $\chi^2$  = 8.853, *p* = 0.003). There were no significant effect of any of age, BMI, or weight on having an indirect vs direct hernia.

### Hospital Stay Duration and Pain Medications Administered

Duration of hospital stay was not significantly different between the open and laparoscopic surgeries (Table 2); however, there was a significant correlation between age and duration of hospital stay (*R* = 0.314, *p* = 0.012). Medications given during the immediate postoperative period and the hospital stay included paracetamol, nonsteroidal anti-inflammatory drugs (NSAIDs), and opioid medications (morphine or fentanyl). Participants' analgesic medication for each time period was classified as (i) none, (ii) paracetamol and/or NSAID, (iii) opioid medication, and (iv) a combination of opioid medication with either paracetamol or NSAID.

### Pain Medication in the Immediate Postoperative Period

During the first hour post-surgery, just over half (57%) of all patients did not receive any analgesia and 43% were given opioid medication (fentanyl 20–200 µg or morphine 2.5–15 mg). There was no significant difference between the open vs laparoscopic surgery groups for medication type ( $\chi^2$  = 0.140, *p* = 0.708), or equivalent morphine dose total or per kg body weight (Table 2), or for equivalent morphine dose when only those who received opioid analgesic were considered (*p* = 0.64). There was a trend for an inverse correlation between age and equivalent morphine dose (*R* = -0.243, *p* = 0.055).

### Pain Medication during the Hospital Stay

During the hospital stay, the majority (57%) of all patients received a combination of NSAIDs and opioids, 30% received only paracetamol and/or NSAIDs, 5% received only opioids, and 8% did not receive

**Table 2:** Medication data for patients who underwent open and laparoscopic surgery methods of inguinal hernia repair. Mean  $\pm$  standard deviation with range in parentheses. Between-group comparisons: Student's unpaired *t* tests

|                                   | Open surgery<br>( <i>n</i> = 39) | Laparoscopic surgery<br>( <i>n</i> = 24) | Between-group comparison |
|-----------------------------------|----------------------------------|------------------------------------------|--------------------------|
| Length of hospital stay (days)    | 2.2 $\pm$ 0.8<br>(1–5)           | 2.0 $\pm$ 0.8<br>(1–5)                   | <i>p</i> = 0.496         |
| Medication dose (mg)              |                                  |                                          |                          |
| Recovery Opioid equivalents       | 3.7 $\pm$ 5.9<br>(0–25)          | 4.7 $\pm$ 6.2<br>(0–20)                  | <i>p</i> = 0.553         |
| Opioid equivalents/kg body weight | 0.05 $\pm$ 0.08<br>(0–0.35)      | 0.05 $\pm$ 0.07<br>(0–0.24)              | <i>p</i> = 0.703         |
| Hospital stay Opioid equivalents  | 17.3 $\pm$ 17.7<br>(0–55)        | 15.2 $\pm$ 21.6<br>(0–75)                | <i>p</i> = 0.675         |
| Paracetamol (g)                   | 5.7 $\pm$ 3.7<br>(0–1.6)         | 4.8 $\pm$ 3.9<br>(0–1.6)                 | <i>p</i> = 0.344         |
| NSAID                             | 112 $\pm$ 275<br>(0–1200)        | 209 $\pm$ 601<br>(0–2800)                | <i>p</i> = 0.394         |
| Opioid equivalents/kg body weight | 0.22 $\pm$ 0.23<br>(0–0.75)      | 0.19 $\pm$ 0.26<br>(0–0.76)              | <i>p</i> = 0.259         |
| Paracetamol (g)/kg body weight    | 0.07 $\pm$ 0.05<br>(0–0.17)      | 0.06 $\pm$ 0.05<br>(0–0.24)              | <i>p</i> = 0.583         |

any medication. There were no significant difference between surgery groups for medication type ( $\chi^2 = 1.993$ , *p* = 0.574), for equivalent morphine dose total or per kg body weight (Table 2), or for equivalent morphine dose when only those who received opioid analgesic were included in analysis (*p* = 0.88). There was no correlation between age and equivalent morphine dose (*R* = 0.025, *p* = 0.844).

### Influences of BMI

The BMI group (15 healthy weight, 37 overweight, and 11 obese patients) had no significant effect on the distribution of medication type received during the immediate postoperative period ( $\chi^2 = 1.508$ ; *p* = 0.471), but did have a significant influence on category of pain medication required during the hospital stay ( $\chi^2 = 12.783$ ; *p* = 0.047). During this time, the majority of overweight and obese patients (62 and 60%, respectively) but less than half (43%) of healthy patients required a combination of opioids with either NSAID or paracetamol. Among healthy-weight patients, equivalent proportions (21% each) required just opioids or NSAIDs and/or paracetamol, and 14% did not receive any pain medication. In contrast, among overweight and obese patients, none received opioids alone; 33 and 30%, respectively, required only NSAIDs and/or paracetamol; and only 5 and 10%, respectively, did not require any medication. There was no influence of BMI on dose per kg body weight for opioid analgesics received during the immediate postoperative period, or for opioids or paracetamol during the hospital stay ( $F_{2,60} = 1.216$ , *p* = 0.304;  $F_{2,60} = 0.042$ , *p* = 0.959;  $F_{2,60} = 0.546$ , *p* = 0.582, respectively). The BMI also significantly influenced hospital stay duration ( $\chi^2 = 20.74$ ; *p* = 0.008): the majority of healthy patients (72%) stayed 1–2 days, and

overweight patients (87%) stayed 2 days, and all obese patients stayed at least 2 days.

### DISCUSSION

Just over one-third (38%) of inguinal hernia repairs in the current study were conducted using laparoscopic surgery, which is similar to the overall Australian rate for the 15 years prior, of 43%.<sup>1</sup> Overall, there were no significant differences between patients who underwent open vs laparoscopic surgery for inguinal hernia repair in terms of type and dose of analgesic medications given during the immediate postoperative period or the hospital stay, or the duration of the hospital stay. However, there was an influence of BMI on several measures, with increased BMI associated with requiring a combination of opioids with NSAIDs or paracetamol rather than none of, or any of these alone, and with a longer hospital stay, which is clinically relevant. Patients in the open surgery group were significantly older, which reflects Australian epidemiological data that elderly patients are less likely to undergo laparoscopic surgical repair of groin hernias.<sup>1</sup> Further, age was significantly correlated with hospital stay duration, and almost significantly (*p* = 0.055) inversely correlated with equivalent morphine dose in the postoperative period, so this is a confounding factor. Patients who underwent laparoscopic surgery and patients with a direct hernia were significantly more likely to have had a previous hernia repair. Overall, there was large variation in the total dose of all medications given.

The current finding of no difference in analgesic consumption after open vs laparoscopic surgery during the immediate postoperative period and hospital stay is in contrast with much previous research.<sup>5,10–12,14,20,21</sup> These studies all reported significantly lower pain medication requirements after laparoscopic compared with open surgery for inguinal hernia repair. Notably, in the current study, patients who underwent open surgery were significantly older, and there was an inverse correlation, close to significant, between age and equivalent morphine dose in the postoperative period. This is in line with previous reports that younger age is associated with increased perception of chronic pain,<sup>15,23</sup> but may have masked any between groups difference in analgesic medication administration because of the confounding effects of age and pain. In the case of age-matched groups, analgesic requirements may have been less after laparoscopic vs open surgery, as per the above-mentioned previously reported findings. Interactions between surgery mode and age should be included in comparisons of different surgical methods for more accurate results.

A limitation of previous research examining analgesic doses after inguinal hernia repair is that opioid medications were not included in analyses. In the current study, the majority of patients (62%) received opioid medication (mean of 16.5  $\pm$  2.4 mg) during their hospital stay. The proportion of patients receiving opioid medication in the current study was higher than, but the dose was similar to, a comparable study that reported 40% of patients took opioid analgesics (most common total intake of 10–20 mg) for up to 1 week post-surgery.<sup>26</sup> Given the widespread opioid tolerance and abuse and the increasing move to avoid opioids for surgical pain, including after inguinal hernia repair,<sup>27</sup> it is crucial that opioid consumption is assessed, particularly when comparing surgical modalities. Further, in the current study there was a significant effect of BMI on the analgesic profile during the hospital stay, with overweight and obese participants more likely to require a combination of opioid and NSAIDs, rather than just NSAIDs or



paracetamol alone, or no analgesia. However, opioid dose per kg body weight did not differ based on the BMI category, contradicting a previous report of 30% less morphine consumption per kg body weight in obese than healthy-weight patients.<sup>28</sup> Given the increased prevalence of intake of opioid(s) in combination with NSAID and/or paracetamol among patients with higher BMI in the current study, and that higher BMI is a predictor of chronic pain post-surgery,<sup>15,23</sup> which has a significant health burden, this is clinically relevant.

Duration of hospital stay did not differ after open vs laparoscopic surgery, which reflects the findings of an earlier study.<sup>20</sup> However, age was a confounding factor, with a significant correlation between age and hospital stay duration. Considering that patients in the open surgery group were significantly older than those in the laparoscopic group, with age-matched groups, open surgery may have been associated with a shorter hospital stay duration. The influence of BMI on hospital stay duration, whereby obese patients stayed an average extra day compared with those with a healthy BMI contradicts a previous study of no significant difference between those with a BMI greater or less than 30 kg/m<sup>2</sup> on hospital stay after incisional hernia repair.<sup>29</sup> The impact of a higher BMI on hospital stay is significant in terms of health economics considering the large costs associated with this.<sup>30</sup>

There were several limitations to the current study. This research included a relatively small sample size ( $n = 63$ ); however, this is similar to previous studies of total patient numbers ranging between 50 and 100.<sup>12,14,20-22</sup> Because of the large variability in patients' analgesic requirements, greater investigation into the influence of patient characteristics in a larger cohort, alongside subjective measures of pain, would provide more information on the determinants of this. Further, a longitudinal study design to assess return to activities of daily living as well as chronic pain and analgesia consumption would provide better data with respect to patient impact and the wider health burden.

Overall, this study demonstrated that patient characteristics of age and BMI influence analgesic consumption during, and duration of, the hospital stay following repair of inguinal hernia, with no main effect of the surgery mode. Further research is warranted with respect to the interactions between patient characteristics and recovery following open and laparoscopic surgical repair modes for inguinal hernia repair, with the ultimate goal being optimal patient recovery.

## CLINICAL SIGNIFICANCE

Postoperative analgesic requirements in inguinal hernia repair is significantly impacted by patient factors of age, BMI, and previous inguinal hernia repairs. Patient characteristics need to be considered in future research and assessment of postoperative pain in inguinal hernia surgery.

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