

Does exhalation while rising from the bed relieve motion-induced pain after abdominal surgery?

Hisao Sakagami ^{1,2,*}, Atsushi Otomo ¹, Hideyuki Nakae ³, Ryoichi Nagatomi ²

¹ Department of Rehabilitation Science, Sendai Seiyo Gakuin College, 4-3-55 Nagamachi, Taihaku, Sendai, Miyagi, Japan

² Department of Medicine and Science in Sports and Exercise, Tohoku University Graduate School of Medicine, 2-1 Seiryotyo, Aoba-Ku, Sendai, Japan

³ Faculty of Health Sciences, Tohoku Fukushi University, 6-149-1 Kunimigaoka, Aoba-ku, Miyagi, Sendai, Japan

*Corresponding Author:

Hisao Sakagami

Department of Rehabilitation Science, Sendai Seiyo Gakuin College,

4-3-55 Nagamachi, Taihaku, Sendai, Miyagi, Japan

Phone:+81-22-308-2071

E-mail: h_sakagami@seiyogakuin.ac.jp

Abstract

Background: After abdominal surgery, patients may strongly complain of pain during exercise, especially during the motion of rising from the supine to a sitting position. The effect of exhalation on wound pain relief during the rising motion was examined.

Methods: Seventy-seven patients who had undergone open renal biopsy and 11 patients who had undergone inguinal hernia repair surgery were made to rise, and subsequently, after a break, were instructed to perform the rising motion while exhaling. The wound pain associated with the rising motion before and after the instruction to exhale was compared and examined.

Results: In patients who had undergone open renal biopsy or hernia repair, wound pain during the rising motion was significantly reduced when the rising motion was performed with exhalation, compared to the pain when they did not exhale while rising.

Conclusion: This study suggests that abdominal surgery wound pain is relieved when the rising motion from a supine to a sitting position is performed while exhaling.

Trial registration: This study was retrospectively registered at ISRCTN registry with study ID ISRCTN95502262.

Keywords: rising movement, expiration, wound pain, open renal biopsy, inguinal hernia repair

Background

Surgery is painful, and relieving postoperative pain is one of the important tasks of patient management. However, if pain continues, it may be difficult for the patient to leave the bed earlier, and it is reported that receiving appropriate pain management, such as anesthesia, decreases the hospitalization period [1,2] and improves the quality of life [3]. It is considered desirable for patients to leave the bed earlier in order to prevent muscle wasting and pulmonary complications, but the continuation of postoperative pain may hinder this.

In Apfelbaum et al.'s survey of 250 patients who underwent surgery in the United States of America, 82% experienced pain after surgery; 47% of these patients had moderate pain, while 39% reported severe to extreme pain [4]. Gould et al. examined 1,421 subjects who underwent major surgical procedures such as laparotomy, intermediate surgical procedures such as inguinal hernia repair, and minor surgical procedures such as varicose vein treatment and thyroidectomy; they investigated pain during relaxation, pain on movement, and pain on deep inspiration, and found that pain on motion was the most intense [5]. Srikandarajah and Gilron reported that various maneuvers evoked pain during the first 3 postoperative days, and that among the pain-evoking maneuvers, cough and sitting up were most frequent in patients who had undergone abdominal hysterectomy [6].

Based on this background, local anesthetic at the incision site, transversus abdominis plane block, epidural with local anesthetic or intrathecal opioids, and epidural anesthesia are strongly recommended

in the guidelines for postoperative pain management of the American Pain Society, the American Society of Regional Anesthesia and Pain Medicine, and the American Society of Anesthesiologists' Committee on Regional Anesthesia, Executive Committee, and Administrative Council [7].

However, Apfelbaum et al. reported that 23% of patients who received pain medication after surgery experienced adverse effects [4]. Koh et al. investigated the incidence of adverse effects of epidural anesthesia in 2,435 postoperative patients in Korea, and found a high incidence of numbness and motor paralysis in young people (67.8%), while these were found in 11.5% of the elderly. Likewise, it was reported that low blood pressure is experienced by 3.1% of young people and 20.3% of the elderly after surgery, and that the incidence of hypotension and vomiting is higher in the elderly than in younger patients [8]. Therefore, a nonpharmacological method for relieving pain is desired. However, many methods for relieving pain are not strongly recommended in the guidelines for postoperative pain management by the abovementioned academic society and committee, because the scientific evidence is poor.

It is thought that the high incidence of pain accompanying a rising motion after laparotomy occurs due to the application of tension to the wound site, which accompanies the activity of the abdominal muscle group. When getting up during inspiration, the abdominal organs are being pressed upon by the descent of the diaphragm [9], and the force applied to the abdominal wall is considered to be greater during inspiration than during expiration. Pain relief can be aimed for by properly controlling

breathing movements.

Our working hypothesis was that wound pain could be relieved by exhaling during the rising motion. Therefore, we attempted to verify the hypothesis that patients who had undergone abdominal surgery and got up while exhaling could experience relief of wound pain.

Methods

Subjects

Ninety-four patients who underwent either open renal biopsy or conventional inguinal herniation repair surgery were informed about the study 1–3 days after the surgery, when they were allowed to move about on their own. Fourteen patients who did not complain of motion-evoked pain were excluded from the study. Eligible patients with motion-evoked pain who gave full informed consent to participate in the study were as follows: 77 patients who had undergone open renal biopsy – 49 males and 28 females, with an average age of 47.2 ± 19.4 years; and 11 patients who had undergone conventional inguinal hernia repair – 10 males and 1 female, with an average age of 68.6 ± 15.0 years (Table 1). All of the surgical procedures followed the standardized method, in which the skin incisions were made as follows: in the open renal biopsy, the skin incision was made 2–3 cm under one transverse finger from the lower end of the 12th rib, with dissection of the frontal oblique muscle fascia and abdominal fascia; and in the inguinal hernia repair surgery (conventional method) a

transverse skin incision of about 4 cm was made at one transverse finger above the midpoint between the pubic nodule and the superior iliac spine, after which the external oblique aponeurosis was dissected.

Intervention

As per the standard clinical norms, unless there is a sign of any type of clinical complication, patients are advised to avoid bed rest 3–5 days after surgery, and are allowed to leave the bed for trips to the bathroom and meals. Before the first time they rose from the bed, patients were asked to score the pain of their surgical wound upon rising from a supine position to a sitting position, without any instruction to exhale, using a visual analog scale (VAS) of 10 cm. After a break, they were told to return to the supine position, and asked to exhale while rising to the sitting position. Immediately after the second rise, they were asked to rate their pain and stress using the VAS scale.

The difference in the mean VAS score for wound pain with or without exhalation was compared, and the statistical significance was tested using the Student's t-test. IBM SPSS Statistics Version 22.0 (IBM, Cary, NC, USA) was used for the statistical analysis, and the level of statistical significance was set at 5%.

Results

There were 91 eligible patients who underwent open renal biopsy, but 14 patients did not complain of motion-evoked pain after surgery, therefore, 77 patients were included in the study. There were 13 eligible patients who underwent inguinal hernia repair, and 2 did not complain of motion-evoked pain after surgery.

In the open renal biopsy patients, wound pain induced by the rising motion was significantly reduced ($p < 0.01$) when they exhaled upon rising from the bed, compared to the pain when rising without exhalation (Table 2). There was one person whose pain score increased by 13 mm upon exhalation. In 9 patients there was no difference in the pain score with or without exhalation upon rising. The average reduction in the pain score of the remaining 67 patients was 19.9 mm.

In the inguinal hernia repair patients, the wound pain induced by the rising motion was significantly reduced ($p < 0.01$) when they exhaled upon rising from the bed, compared to when they rose without exhalation (Table 3). In 2 patients there was no difference in the pain score with or without exhalation upon rising. The average reduction in the pain score of 9 patients was 18.7 mm.

Discussion

The results of this study clearly show that a simple instruction to exhale upon rising from a supine to a sitting position significantly reduced motion-induced pain of the surgical wound during rising in most of the open renal biopsy and inguinal repair patients.

The sites of the surgical incision are different in open renal biopsy and inguinal hernia repair surgery—the former being in the upper abdominal region and the latter in the lower abdominal region—but the incisions were transverse in both procedures. However, irrespective of the site of incision, most of the patients suffered motion-evoked pain upon rising. A simple instruction to exhale may therefore be effective in reducing the pain in patients who undergo abdominal surgery without any sort of side-effects. Because the type of mechanical stress may not be identical, the effect of exhalation needs to be examined in those who have undergone surgery involving midline or parallel to midline abdominal incisions, such as in stomach and liver surgery, and cesarean section.

Using the National Clinical Database, the Japan Surgical Society reported that the number of surgeries on gastrointestinal and abdominal internal organs in 2017 in Japan was about 860,000 per year, and among them the percentage of laparoscopy was about 36% [10]. The number of laparoscopic operations is increasing [10], and one of the advantages of laparoscopic surgery is considered to be the smaller size of the incision wounds. It was therefore expected that the need for pain management would be decreased after surgery using this technique. However, Ekstein and colleagues reported that the cumulative postoperative pain score was higher in the laparoscopic patients than in the open laparotomy patients, and that the frequency of analgesic administration was significantly higher in the laparoscopic patients [11]. Therefore, simple instruction on exhalation may also be effective for patients undergoing laparoscopic surgery, and may lead to a reduction in pain medication dosage. This

needs to be further investigated.

After surgery about two-thirds of patients complain of pain [4]. This simple instruction regarding exhalation, rather than medication, may not only relieve the motion-evoked pain of patients undergoing abdominal surgery, but may also be effective in removing the fear of moving, which may further lead to a reduction in the number of days of hospitalization.

Among the 91 patients, there were 9 patients in open renal biopsy and 2 patients in inguinal hernia repair whose pain score were the same even after the instruction of exhaling while rising. It is possible that these patients had already been performing exhalation while rising. Further study is necessary to be confirmed in the future studies.

There are several limitations to this study. While the study participants tried to follow the instruction of exhalation given by the investigator, there was no objective way of examining the exhalation. It is possible that some patients who did not experience any reduction in the evoked pain were not exhaling correctly. An objective and simple way of monitoring breathing behavior may further verify the effect of exhalation for pain relief upon rising.

Conclusion

This study suggests that wound pain is relieved in abdominal surgery patients when they exhale while rising from a supine to a sitting position in bed. This simple maneuver of exhalation while rising is a

relatively easy way without any sort of adverse or side-effects and may be advised more frequently to relieve pain upon rising after abdominal surgery.

List of abbreviations

VAS: Visual analog scale

Declarations

Ethics approval and consent to participate

The protocol of this study assured free participation of the patients in the study, based on the Declaration of Helsinki, and was approved by the Sendai Society Insurance Hospital (now JCHO Sendai Hospital) Ethics Review Committee (approval number: # 2011-13). All study participants provided informed consent in the written form prior to the study.

Consent for publication

Not applicable.

Availability of data and materials

The informed consent from the patients did not include the opportunity to provide the data to

researchers other than the authors, nor to make the data open to the scientific community. It is almost impossible to reach the patients who participated in this study in order to ask for a revised agreement.

Competing interests

There is no conflict of interest regarding this study.

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Authors' contributions

HS performed the literature search, designed the study, recruited the study participants, and collected the data. AO provided the protocol for pain evaluation and analyzed the data. HS drafted and edited the manuscript in collaboration with HN and RN. All authors have read and approved the final manuscript.

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Table 1

Basic Attributes of Subjects

	Open renal biopsy (n = 77)	Inguinal hernia repair (n = 11)
Age (years)	47.2 ± 19.4	68.6 ± 15.0
Male / Female	49/28	10/1

Numbers or average ± standard deviation

Table 2

Changes in wound pain during rising motion in open renal biopsy patients (n = 77)

	No instruction	Exhalation indicated
VAS (mm)	39.8 ± 21.7	22.7 ± 16.1***

Mean ± standard deviation. ***: $p < 0.001$. VAS, visual analog scale

Table 3

Changes in wound pain during rising motion in renal post-inguinal hernia repair patients (n=11)

	No instruction	Exhalation indicated
VAS (mm)	35.6 ± 16.6	21.3 ± 9.9*

Mean ± standard deviation. *: $p < 0.05$. VAS, visual analog scale