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A Longitudinal Study of Patient Reported Positioning-Related Discomfort and Pain after Laparoscopic Surgery in the Lithotomy Position

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Abstract

Background: Our hypothesis was that only established and persistent injuries and complications after positioning in the Trendelenburg position are reported and detected, despite that patients may have great discomfort after surgery. **Aim:** The aim of this study was to explore patient reported discomfort, pain and functional decrease two hours, 24 hours and four weeks after laparoscopic resection of the colon in the prone lithotomy position, as well as factors potentially associated with reported pain. **Methods:** A longitudinal self-report questionnaire study was conducted at three time-points. **Results:** A total of 37 patients responded. Findings show that patients mostly reported pain in relation to the surgical area, but also related to other areas that may be linked to positioning. **Conclusion:** Even though patients reported mild pain, several of the patients still reported this, four weeks postoperatively, as well as some functional decrease. Our findings support the need to focus on preventing positioning injuries.

Keywords

Positioning Injuries, Operating Room Nursing, Pain, Discomfort, Functional Decrease

1. Introduction

Every surgical procedure requires positioning the patient so the surgeon has optimal access to the surgical field, also enabling placement of necessary equipment

for anesthesia and surgery [1] [2]. Patients undergoing surgery are immobile and unable to change position when exposed to prolonged pressure, because of sedation and anesthesia [3]. Hence, positioning injuries are a known surgical complication that can result in significant patient morbidity [4]. Injuries may occur due to pressure against nerves or tissue caused by inadequate positioning, inadequate padding, or improper body alignment. The locations and types of potential injuries such as stretching, compression, or pressure ulcers, are closely related to the surgical position. The length of the procedure as well as patient related risk factors such as weight, age, or frailty, are associated with an increased risk of positioning injuries [5] [6] [7].

The lithotomy position is used for a variety of open and endoscopic surgeries in the pelvic area. The patient is lying on the back with the legs flexed 90 degrees at the hips, and knees bent at 70 to 90 degrees, left arm abducted 90 degrees and right arm along the body. Most commonly, padded foot rests or stirrups attached to the operation table are used to support the legs. In gastric surgery, a prone lithotomy position (Trendelenburg) is recommended, where the patient is positioned in a 15 - 30 degree incline with the feet elevated above the head [4] [7]. Both the lithotomy and the Trendeleburg position have been associated with positioning injuries. For example, neurologic injuries related to the lithotomy position may affect the femoral, sciatic, and common peroneal nerves, or even lead to acute compartment syndrome. Trendelenburg positioning may cause potentially life-threatening complications of the respiratory and cardiovascular systems. Postoperative loss of vision has also been reported [8] [9].

Patient reported experience is an acknowledged quality parameter, assumed to be less subjective than patient satisfaction [10] [11]. Information about patient experiences gives an opportunity to improve health services, meet patient expectations, and administer and monitor health service provision [12]. Positioning-related injuries seem to be under-reported [13] [14]. Moreover, studies mainly focus on treatment-requiring complications, while research on longitudinal ailments or discomfort is lacking [15]. According to our experience as operating room nurses/nurse anaesthetists, operating room personnel receive little or no information from the postoperative anaesthesia care unit (PACU) and postoperative surgical ward units regarding patients' experience of pain or discomfort that could be associated with the surgical positioning.

Positioning the patient is a shared responsibility between surgeons, anesthesia personnel (anaesthesiologists and nurse anaesthetist) and operating room nurses. Nevertheless, the patient's surgical positioning remains an important procedure in intraoperative nursing care, and nurses most commonly are responsible for providing necessary equipment and paddings, as well as monitoring and observation [16] [17]. Increased knowledge about patient reported experiences with discomfort, pain and/or functional decrease that may be linked to positioning may discover areas that need emphasis perioperatively to prevent such adverse events.

Our hypothesis was that only established and persistent injuries and complications are reported and detected, despite the fact that patients may have great discomfort after surgery. Consequently, the aim of this study was to explore patient reported discomfort, pain and functional decrease at two hours, 24 hours and four weeks after laparoscopic resection of the colon in the prone lithotomy position. In addition, we aimed to assess possible associations between factors such as gender, age, weight, height, American Association of Anaesthesiologists (ASA) classification, length of surgery/length of procedure and pain score.

2. Materials and Methods

The study had a longitudinal, quantitative design, utilizing a self-report questionnaire to patients at two hours, 24 hours and four weeks postoperatively. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies were used [18].

2.1. Setting and Participants

The study was conducted in a hospital in Southeastern, Norway, with a catchment area of 320.000 inhabitants. We used a strategic, consecutive sampling method. All patients fulfilling the inclusion criteria, undergoing a low anterior laparoscopic resection of the colon in the prone lithotomy position, in the period May 2020-January 2021, were invited to participate. Inclusion criteria were; patients above 18 years old, able to provide their oral and written consent to participate, without any cognitive dysfunction or dementia, and able to read and understand Norwegian language. Exclusion criteria were patients with an established neuro-muscular disease. Three of the invited patients rejected to participate.

Results from a study on robotic assisted laparoscopic radical prostatectomy in the lithotomy/Trendelenburg position found that patients had a mean postoperative pain score of 3.6 (standard deviation, SD = 1.2) [19]. With pain score as primary outcome, minimal difference of interest in pain score = 1.2, assuming a level of significance of 5%, and power = 80%, a one-sided calculation indicated that we would need to include a total of 32 patients, as calculated by a statistician.

2.2. Instruments and Procedure

Patients scheduled for elective laparoscopic resection of the colon were informed both oral and in writing (consent-form) about the study and the opportunity to participate when attending a preoperative evaluation appointment in hospital, a few weeks before surgery. Patients delivered their signed consent-form at the day of surgery.

Participants were asked to complete a questionnaire at three time-points:

T1: two hours postoperatively, in the PACU

T2: 20 - 24 hours postoperatively, in the postoperative surgical ward

T3: four weeks postoperatively, at home

The questionnaire consisted of three parts:

1) The validated self-report short form of the "McGill Pain Questionnaire" (MPQ), the SFMPQ, one of the most widely used multidimensional pain scales in the world (Cronbach's Alpha = 0.75 - 0.91). The SFMPQ consists of 15 descriptors of pain. Each descriptor is ranked on an intensity scale, where 0 = none, 1 = mild, 2 = moderate and 3 = severe [20]. The SFMPQ also included a body-map, where participants can mark where they experience pain, readness or swelling.

2) A numerical rating scale (NRS). This is an 11-point scale from 0 - 10, where no pain is NRS = 0, mild pain is NRS = 1 - 3, moderate pain NRS = 4 - 6 and severe pain NRS = 7 - 10 [21] [22].

3) Information about patients' age, civil status (married/single/widow(-er)/in a relationship), living arrangements (living alone or not), educational level (elementary school/high school/university or university college), and work situation (working or not).

At T3 the questionnaire also included functional status on ten different activities (exhausting, moderate, carrying groceries, walk several stairs, walk one stair, squat, walk over two kilometers, walk some hundred meters, walk hundred meters, get dressed) based on a questionnaire utilized by the Norwegian Association of Pain. Here, variables have been chosen based on their prognostic value in previous studies investigating generic prognostic factors across different pain locations [23]. The patients' functional level was measured on a three point scale, where 1 = yes, limits me a lot, 2 = yes, limits me some, 3 = do not limit me at all.

The questionnaire was paper-based, and followed the patients throughout their pathway in hospital. Study nurses assisted in completing and/or collecting the questionnaires. Four weeks after discharge, telephone interviews based on the T3 questionnaire were conducted by the researchers.

In addition, information about the patients' body weight, height (to be able to calculate BMI), American Association of Anaesthesiologists (ASA) classification and length of surgery was registered in the patients' paper-based questionnaire by study nurses peroperatively.

2.3. Analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS), version 26. No methods for calculation of missing data were used, and missing data were excluded from the analyses. Frequencies were used to present characteristics of the study sample. Due to data not being normally distributed, continuous variables were summarised by their median standard deviation. All tests were two - sided and used a significance level of 0.05. The paired-samples t-test was used to compare scores at T1 and T2, and T2 and T3 respectively. A univariate linear regression model using "current pain" as dependent variable, and gender, age, ASA-classification, weight, height, length of surgery and length of

procedure as covariates was run to explore for associations.

2.4. Ethics

The study was conducted in-line with principles for ethical research in the Declaration of Helsinki [24], and based on anonymity, confidentiality, and willing, informed, written consent to participate.

3. Results

In total, 37 patients participated in the study at all timepoints; 40 at T1, 42 at T2 and 37 at T3. Table 1 gives an overview of study participants' characteristics.

3.1. Pain Scores Longitudinally

Table 2 gives an overview of participants' reported pain and location at the three different timepoints.

Table 1. Descriptives of the study participants (n = 42).

Gender (male, n=)	19
Weight (mean)	81 (18.6)
Height (mean)	175 (9.1)
ASA (n=)	
I	1
II	29
III	10
Civil status (n=)	
Married	31
Single	5
Widowed	6
Living alone (n=)	
Yes	10
No	32
Level of education (n=)	
Primary school	9
High school	25
University/university college	8
Is working	
Yes	11
No	31
Length of surgery (minutes, mean)	282 (128)
Length of procedure (minutes, mean)	368 (135.8)

Standard deviation (SD) in parenthesis.

Table 2. Patients' reported pain and location at T1, T2 and T3 respectively.

	T1 (n = 40)	T2 (n = 42)	T3 (n = 37)
Current pain			
Mean (SD)	3 (2.2)	2 (2.2)	0 (2)
Range	0 - 9*	0 - 7**	0 - 2***
	n=	n=	n=
Pain			
Chest	-	4	-
Forehead	1	1	-
Umbilicus	21	17	14
Pelvic area	5	8	-
Neck	-	1	1
Back	5	4	3
Gluteus	-	4	3
Right shoulder	-	6	1
Left shoulder	-	4	1
Read/swollen			
Yes	4	3	1
No	36	39	35
Location			
Forehead	1	1	-
Umbilicus	1	-	1
Gluteus	1	-	-
Pelvic area	-	1	-
Thigh (right)	1	-	-
Right hand	-	1	-
Strongest pain last month			1.3 (3.8)
Strongest pain last month, range			0 - 7
Weakest pain last month			0.3 (1.2)
Weakest pain last month, range			0 - 3

Pain scored on a scale from 0 = no pain to 10 = worst imaginary pain. *At T1, seven patients scored the current pain = 0, and 1 patient scored the current pain = 9. **At T2, 15 patients scored the current pain = 0, and three patients scored the current pain = 7. *** At T3, 18 patients scored the current pain = 0, and two patients scored the current pain = 2. T1 = two hours postoperatively, T2 = 20 - 24 hours postoperatively, T3 = Four weeks postoperatively. No significant differences were identified between T1 and T2, between T1 and T3, or between T2 and T3 as measured by the paired samples t-test.

Table 2 shows that the participants in average experienced limited pain at all time-points, even though the pain range was from 0 to 9 at T1, and from 0 to 7 at T2. The table also shows that the location of pain varied both between participants and between time-points.

3.2. Pain Characteristics Longitudinally

Table 3 gives an overview of participants' characterization of their experienced pain at the three time points.

Table 3. McGill pain scores. Number of participants characterizing pain at two hours (T1), 20 - 24 hours (T2) and four weeks (T3) postoperatively.

	T1 (n = 40), n =	T2 (n = 42), n=	T3 (n = 37), n=
Throbbing pain			
No pain	37	41	37
Weak pain	2	-	-
Moderate pain	1	1	-
Strong pain		-	-
Shooting pain			
No pain	37	40	37
Weak pain	3	2	-
Moderate pain	-	-	-
Strong pain		-	-
Stabbing pain			
No pain	36	32	33
Weak pain	-	5	2
Moderate pain	2	4	1
Strong pain	2	1	1
Sharp pain			
No pain	39	38	37
Weak pain	1	2	-
Moderate pain	-	2	-
Strong pain	-	-	-
Cramping pain			
No pain	35	40	37
Weak pain	4	1	-
Moderate pain	-	-	-
Strong pain	1	1	-
Gnawing pain			
No pain	34	40	37
Weak pain	4	1	-
Moderate pain	1	1	-
Strong pain	1	-	-
Hot-burning pain			
No pain	37	36	37
Weak pain	1	3	-
Moderate pain	1	2	-
Strong pain	1	1	-

Continued

Aching pain			
No pain	20	29	24
Weak pain	7	3	9
Moderate pain	9	9	3
Strong pain	4	1	1
Heavy pain			
No pain	35	37	35
Weak pain	1	1	1
Moderate pain	3	3	-
Strong pain	1	1	1
Tender pain			
No pain	25	30	35
Weak pain	8	4	1
Moderate pain	5	6	-
Strong pain	2	2	1
Splitting pain			
No pain	38	39	37
Weak pain	2	-	-
Moderate pain	-	3	-
Strong pain	-	-	-
Tiring-exhausting pain			
No pain	35	37	35
Weak pain	2	2	-
Moderate pain	-	1	1
Strong pain	3	2	1
Sickening pain			
No pain	37	39	35
Weak pain	-	2	1
Moderate pain	-	-	1
Strong pain	3	1	-
Fearful pain			
No pain	39	39	37
Weak pain	1	2	-
Moderate pain	-	-	-
Strong pain	-	1	-
Punishing-cruel pain			
No pain	39	41	36
Weak pain	1	-	-
Moderate pain	-	-	-
Strong pain	-	1	-

No significant differences were identified between T1 and T2, between T1 and T3, or between T2 and T3 as measured by the paired samples t-test.

Table 3 shows that "aching pain" characterized the participants' pain most frequently, followed by "tender pain". Mostly, pain was reported to be weak.

3.3. Functional Decrease at Four Weeks

Table 4 gives an overview of participants' experienced functional decrease four weeks postoperatively.

Table 4 shows that even after four weeks, some of the participants experienced limitations in functional capacity. Most frequently, this was related to "exhausting activities".

3.4. Factors Associated with Pain Scores

Running a multiple logistic regression model with "current pain" as dependent variable, and gender, age, ASA-classification, weight, height, length of surgery and length of procedure as covariates, we identified no significant associations, even when removing covariates one by one according to highest p-value. The model was run with "current pain" as dependent variable at T1, T2 and T3 respectively, identifying no significant associations.

4. Discussion

Initially, it may seem like patients most frequently reported no or mild discomfort, pain or functional decrease both two hours, 20 - 24 hours and four weeks postoperatively after laparoscopic resection of the colon in the prone lithotomy position. Neither gender, age, weight, height, American Association of Anaesthesiologists (ASA) classification, length of surgery or length of procedure were associated with patients' current pain scores.

The most common area for reporting of pain at all time-points was, naturally, around the umbilicus, the surgical area. Two hours postoperatively (T1), five patients (13.5%) also reported of pain in the pelvic area and in the back, and one patient (2.7%) reported of readness/swelling around umbilicus, in the forehead, gluteus and thigh respectively. According to the US National Pressure Ulcer Advisory Panel Pressure Injury Staging System, nonblanchable erythema is the first stage in identifying pressure ulcers [25]. The readness still remained in one patients' forehead 20 - 24 hours postoperatively, but was gone after four weeks. This readness may be due to pooling of blood in the head due to the prone position. The readness/swelling reported in the pelvic area and one patients' pelvic area and another patients' right hand may also suggest a consistent pressure added peroperatively, that could potentially have led to a pressure injury.

Even if patients reported an overall mild pain score, at T2 four patients (9.5%) also reported of pain in the chest area. We have not been able to identify any studies indicating pain or injuries in this area after laparoscopic surgery in the prone lithotomy position. This may be due to the insufflation of gas, which has been argued in several other studies: for example a study of pain characteristics after total laparoscopic hysterectomy found that 90% of all patients reported of

Table 4. Responses to the functional decrease questionnaire (n = 37).

Areas	n=
Exhausting activities	
Limits me a lot	6
Limits me some	15
Do not limit me at all	16
Moderate activities	
Limits me a lot	2
Limits me some	5
Do not limit me at all	30
Carry things	
Limits me a lot	2
Limits me some	6
Do not limit me at all	29
Walk up several stairs	
Limits me a lot	1
Limits me some	2
Do not limit me at all	34
Walk up one stair	
Limits me a lot	-
Limits me some	1
Do not limit me at all	36
To bend down	
Limits me a lot	1
Limits me some	9
Do not limit me at all	27
Walk two kilometers	
Limits me a lot	4
Limits me some	13
Do not limit me at all	20
Walk a few hundred meters	
Limits me a lot	1
Limits me some	2
Do not limit me at all	34
Walk hundred meters	
Limits me a lot	-
Limits me some	1
Do not limit me at all	36
To get washed	
Limits me a lot	-
Limits me some	1
Do not limit me at all	36

shoulder pain [26]. Another study on patients undergoing laparoscopic cholecystectomy found that shoulder tip pain was most at 24 h and gradually decreased thereafter [27], which may be supported by our findings showing that ten patients (23.8%) reported of pain in either the right or left shoulder at 20 - 24 hours postoperatively. A study from 2000 found that the incidence of shoulder tip pain after laparoscopic cholecystectomy varies greatly with some studies reporting incidences as high as 30% - 50%. The authors argued that since type of pain, intensity, and duration of pain varied between different patients and was largely unpredictable, such pain is difficult to prevent [2]. The more worrying results are that 14 patients (37.8%) still reported pain in the surgical area four weeks postoperatively, even if the pain was rated as mild. Moreover, patients reported of mild pain the neck (n = 1), back (n = 3), gluteus (n = 3), right shoulder (n = 1) and left shoulder (n = 1) at this time-point. Earlier studies have reported of injuries on the femoral, sciatic, and common peroneal nerves due to the lithotomy position [8] [10]. Unfortunately, we did not specify in the questionnaires that patients should reflect on whether they assumed their pain could be related to, or had ocurred after, the surgery. A review of studies on complications after robotic surgery in the Trendeleburg position showed that upper extremity nerve injury had an incidence of 0.25% - 1.8%, and lower extremity nerve injuries had an incidence of 0.3% - 2% [28].

Even if patients reported their current pain as mild, the McGill score characterizing their pain was contradictory. For example, two patients (5.4%) reported of moderate/strong stabbing pain and tiring-exhausting pain, four patients (10.8%) reported of moderate/strong aching pain four weeks postoperatively. A systematic review comparing the Numeric Rating Scale (NRS), the Visual Analougue Scale/VAS) and the Verbal Rating Scale (VRS) for scoring of adult pain intensity found that the NRSs had better compliance, were the recommended tool and had good applicability relative to VAS/VRS [29]. In addition, the scoring on functional level indicated that patients experienced a decrease also four weeks postoperatively.

We could not identify any associations between pain score and factors such as gender, age, weight, height, American Association of Anaesthesiologists (ASA) classification, length of surgery or length of procedure. This contrasts earlier studies, indicating a correlation between e.g. case duration and positioning injuries [22] [30] [31]. Al-Temimi *et al.* found that increasing age was associated with a protective effect (oR = 0.80 (95% Ci, 0.71 - 0.90)) [32]. Moreover, functional status as measured by ASA classification has been associated with an increased risk of peripheral nerve injuries due to the lithotomy position [28].

Our findings indicate that the risk for positioning injuries is underappreciated. Zillioux and Krupski argue that surgeons should discuss the risk of such complications with their patients, and that operative teams should focus on preventing these [33]. Sørensen *et al.* found that operating room nurses judged positioning of the patient as particularly difficult for the prone (438%), lithotomy

(534%) and lateral positions (655%) [34]. The authors concluded that there is a discrepancy between what positioning devices are available on the market and what is found in operation rooms. Preventing positioning injuries may decrease both mortality and morbidity, decreasing the risk of life-altering iatrogenic injuries [35]. Operating room nurses have a responsibility both for positioning patients and for being familiar with the technological developments that may impact the preoperative handling of patients together with the surgical team [36]. Internationally, several tools for risk assessment for development of positioning injuries have been developed, for example the "Risk Assessment Scale for the Development of Injuries due to Surgical Positioning (ELPO)" [21]. The ELPO includes information about surgery, case duration, anaesthesia, padding on the table, location of arms and legs, comorbidity and age. To our knowledge, such mapping tools are not in use nationally in Norway.

Limitations

Our study included a relatively small sample, and we did not identify any statistically significant associations. This may limit the generalizability of our findings. In addition, this could be a threat to utilizing multiple logistic regression models. Still, we reached the calculated sample size. In addition, the study was conducted in one hospital, and one surgical ward. Still, this may also be a strength, since the personnel, the positioning equipment available, and the surgical and anaesthesiological procedures were similar in all patients. We utilized validated tools for self reporting. In retrospect, we see that we should have emphasized that patients should relate their assessments to the surgical procedure and also to their habitual condition. Including observations of the surgical procedure and positioning may have increased our understanding of the reported pain/discomfort in areas such as the chest or the hand.

5. Conclusion

In this study, we did not identify any associations between factors such as gender, age, weight, height, ASA classification, length of surgery/length of procedure and pain score. However, we identified areas that should be focused on to prevent positioning injuries in the future. Even though positioning injuries are not reported, patients may experience pain, discomfort and functional decrease due to the positioning. Operating room nurses may experience that they are responsible for preventing such adverse events, but this is a mutual responsibility in the surgical team.

5.1. Recommendations for Clinical Practice

We hope this article will increase the surgical teams' knowledge about and focus on positioning injuries after surgery in the lithotomy position. We recommend implementation of a tool for assessment of risk for positioning injuries, as well as systematic mapping of patients postoperatively for pain, discomfort and/or

functional decrease in areas distant from the surgical area. Implementation of a digital self-report tool, for example an application (app) for postoperative surveillance of patients may also be appropriate to be able to detect symptoms other than established injuries that need treatment.

5.2. Recommendations for Education

Our findings support the need to focus on positioning and prevention of injuries during education of operating room nurses, and also members of the surgical team. Risk assessment tools may also be implemented in the operating room nurses' curricula.

5.3. Recommendations for Future Research

We suggest that future research focuses on newly implemented positioning due to new surgical techniques such as robotic surgery in the steep Trendeleburg position. Longitudinal studies are needed. In addition, combining methodological approaches such as observations and surveys may be appropriate.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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