



# What Are Risk Factors for an Ileus After Posterior Spine Surgery?—A Case Control Study

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## Abstract

**Study design:** Case-Control Study.

**Objective:** The purpose of this retrospective study is to evaluate risk factors for developing a postoperative ileus after posterior spine surgery.

**Methods:** Patient charts, including radiographs were evaluated retrospectively. Diagnosis of an ileus was confirmed radiographically by a CT scan in all cases. The control group was retrieved by selecting a random sample of patients undergoing posterior spine surgery who did not develop bowel dysfunction postoperatively.

**Results:** A total of 40 patients had a postoperative ileus. The control group consisted of 80 patients. Both groups did not differ significantly in age, gender, BMI, tobacco use, comorbidities or status of previous abdominal surgery. Significant differences between the 2 groups was the length of stay (5.9 vs. 11.2;  $p = 0.001$ ), surgery in the lumbar spine (47.5% vs. 87.5%;  $p < 0.001$ ) and major spine surgery involving  $> 3$  levels (35.0% vs. 57.5%;  $p = 0.019$ ). Patients who suffered from an ileus were more likely to be treated in ICU (23.8% vs. 37.5%;  $p = 0.115$ ), being re-admitted (0.0% vs. 5.0%;  $p = 0.044$ ) and having a delayed discharge (32.5% vs. 57.5%;  $p = 0.009$ ). Multivariable analysis demonstrated that lumbar spine surgery compared to thoracic and/or cervical spine surgery ( $p = 0.00$ , OR 8.7 CI 2.9-25.4) and major spine surgery involving  $> 3$  levels ( $p = 0.012$ ; OR 3.0, CI 1.3-7.2) are associated with developing an ileus postoperatively.

**Conclusion:** Surgeries of the lumbar spine as well as those involving  $> 3$  levels are associated with developing a postoperative ileus. Further studies are needed to expand on possible risk factors and to better understand the mechanism underlying postoperative ileus in spine surgery patients.

## Keywords

spine surgery, complications, postoperative ileus, posterior spine surgery, lumbar spine surgery

## Introduction

Surgery-related bowel dysfunction, such as post-operative ileus, is often a key factor in determining the hospital length of stay (LOS). The etiology of postoperative ileus is multifactorial, including surgical stress, secretion of inflammatory mediators, endogenous opioids in the gastrointestinal tract, changes in hormone levels, as well as imbalances of electrolytes and fluids. Iatrogenic factors, such as opioids administered for postoperative pain also exacerbate postoperative ileus

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and have been the focus of pharmacologic targeting in recent years.<sup>1-3</sup>

Postoperative ileus can result in an extended hospital stay, poorer pain management, slower progression with physical therapy and decreased overall patient satisfaction in pediatric patients who underwent a surgical correction for scoliosis.<sup>3</sup> Studies suggest that early resumption of oral intake and expediting the return of bowel function may result in earlier hospital discharge, quicker postoperative recovery, maintenance of independence, and potentially saving health care expenditure.<sup>4</sup> Since discharge criteria following surgery often include the tolerance of a diet and the passage of bowel movements, even a slight difference in stay length might have a significant socioeconomic impact. Moreover, studies have shown that patients who have a shorter post-operative hospital stay are more likely to resume their normal activities, including returning to work earlier, further emphasizing the importance of shorter LOS.<sup>5</sup>

Severe constipation following surgery should raise suspicion for post-operative ileus. Given the association to LOS, several studies have attempted to expand on post-operative ileus. In terms of prevention, few studies assessing prophylactic medications showed their administration post-operatively to be inefficient in preventing post-operative ileus.<sup>6-8</sup> Analysis of risk factors found thoraco-lumbar fusion surgery, longer surgeries, higher intra-operative blood loss and higher postoperative morphine doses to be associated with post-operative ileus.<sup>9</sup> Nonetheless, given the clinical and economic significance of post-operative ileus, a more extensive risk factor analysis specifically to spine surgeries is still lacking. The purpose of this retrospective study is to evaluate risk factors for developing a postoperative ileus after posterior spine surgery.

## Patient and Method

Due to the relatively rare occurrence of postoperative ileus, we performed a case control study. We used ICD-10 coding ("Surgical Complication-Digestive System") to identify all patients who developed gastrointestinal complications after spine surgery performed at a single institution (Swedish Neuroscience Institute, Cherry Hill campus, WA, USA) from 2013 to 2017. Only patients who experienced an ileus after posterior spine surgery were included in this study. In accordance with the definition of Vather et al, diagnosis of postoperative ileus required 2 or more of following persistent symptoms on the fourth postoperative day and onward: nausea and vomiting, inability to tolerate solid or semi-liquid diet or failure to pass gas or stool during a 24 hour period, abdominal distension and radiological evidence of ileus.<sup>10</sup> Patient charts, including radiographs were evaluated retrospectively. Diagnosis of an ileus was confirmed clinically and radiographically in all cases. The control group (at a 2:1 ratio) was retrieved by selecting a random sample of patients undergoing posterior spine surgery who did not suffer from any type of bowel dysfunction postoperatively. This control group was matched by selecting the same types of procedures, performed by the same group of surgeons over the same time period at the same institution.

## Study Criteria

Cases and controls were included if surgery was performed in our department by the same group of surgeons. Patients were excluded (1) if they underwent the spine surgery in a different hospital, (2) if a minimally-invasive technique was used, (3) or if patients were younger than 18 or older than 85 years of age.

## Risk Factors

The following risk factors were retrieved from the patient's medical records: age, gender, BMI, tobacco use status, presence of major comorbidities (COPD, cardiovascular, diabetes), existing gastrointestinal disorders (constipation, ulcers, bowel syndrome, GERD etc.), previous abdominal surgery, depression/anxiety, alcohol abuse, presence of Parkinson's disease, pre-operative opioid use and level of surgery. Post-operative retrieved variables included type of symptoms, treatment, type of complications, delayed discharge and readmission and reoperation rates. Delayed discharge was defined as the excess of hospital stay after a patient has been considered medically suitable for discharge but was unable to do so due to the occurrence of an ileus.

## Statistical Analysis

Bivariable analysis was performed to compare cases and controls with respect to risk factors. For categorical variables, frequency counts were computed and presented along with their percentages. For continuous variables, means were computed and presented along with their standard deviation. To compare categorical variables, the Chi-square test was used. For continuous outcomes, a t-test was used. For the multivariable analysis comparing cases to controls, we performed a backward stepwise logistic regression setting with p value set at  $<.15$  as the cutoff for variable retention to generate odds ratios (OR) and 95% confidence intervals (CI). All analyses were performed using Stata 13.1 software.

## Results

A total of 63 patients developed a gastrointestinal complication following posterior spine surgery. Out of those, 40 patients had a postoperative ileus and were included as cases. The control group consisted of 80 patients. Both groups did not differ significantly in terms of age ( $60.8 \pm 14.8$  vs.  $64.8 \pm 10.6$ ;  $p = 0.13$ ), female gender (51.3% vs. 42.5%;  $p = 0.37$ ), BMI ( $29.7 \pm 6.9$  vs  $29.0 \pm 6.1$ ;  $p = 0.61$ ), tobacco use (17.5% vs. 15.0%;  $p = 0.73$ ), comorbidities or status of previous abdominal surgery (28.8% vs. 25.0%;  $p = 0.13$ ) in the controls and cases, respectively (Table 1).

Significant differences between the 2 groups has been observed in the length of stay ( $5.9 \pm 7.5$  vs.  $11.2 \pm 8.9$ ;  $p = 0.001$ ), lumbar surgery (47.5% vs. 87.5%;  $p < 0.001$ ) and surgery performed at  $> 3$  levels (35.0% vs. 57.5%;  $p = 0.019$ ), in the controls and cases, respectively (Table 2). Both groups showed symptoms of nausea, vomiting and constipation. Non

**Table 1.** Bivariable Analysis of Baseline Factors.

Baseline Factors	No ileus (n = 80) Mean ± SD or n (%)	Ileus (n = 40) Mean ± SD or n (%)	P-value
Age (years)	60.8 ± 14.8	64.8 ± 10.6	0.131
Sex (Female)	41 (51.3)	17 (42.5)	0.366
BMI (kg/m <sup>2</sup> )	29.7 (6.9)	29.0 (6.1)	0.607
Smoking	14 (17.5)	6 (15.0)	0.729
Alcohol Abuse	11 (13.8)	6 (15.0)	0.853
Cardiovascular	37 (46.3)	21 (52.5)	0.518
COPD	7 (8.8)	5 (12.5)	0.519
Diabetes	19 (23.8)	7 (17.5)	0.433
Depression/Anxiety	25 (31.3)	13 (33.3)	0.819
GERD	11 (13.8)	3 (7.5)	0.315
Parkinsons	1 (1.3)	1 (2.5)	0.614
Preop Opioids	31 (38.8)	19 (47.5)	0.359
Previous Abd. Surgery	31 (28.8)	10 (25.0)	0.134

**Table 2.** Bivariable Analysis of Surgical Characteristics.

Surgical Characteristics	No ileus (n = 80) Mean ± SD or n (%)	Ileus (n = 40) Mean ± SD or n (%)	P-Value
Length of Stay (days)	5.9 ± 7.5	11.2 ± 8.9	0,001
Localization of Surgery			
Cervical/Thoracic	45 (56.3)	5 (12.5)	<.001
Lumbar	38 (47.5)	35 (87.5)	<.001
Major Spine Surgery	28 (35.0)	23 (57.5)	0,019
Post op Opioids	70 (87.5)	36 (90.0)	0,688
Post op Opioids Decrease	2 (2.5)	0 (0.0)	0,313
Post op Opioids Stable	28 (35.0)	19 (47.5)	0,186
Post op Opioids Increase	39 (49.4)	16 (40.0)	0,333
Preop Gastrointestinal Disorder	0 (0.0)	3 (7.5)	0,013

bowel-related complications included urinary tract infection (n = 5), vascular injury (n = 1), pneumonia (n = 7), surgical site infection (n = 7) and DVT (n = 1). Patients who suffered from an ileus had a higher risk of ICU treatment (37.5% vs. 23.8%; p = 0.12), re-admissions (5.0% vs. 0.0%; p = 0.04) and delayed discharge (57.5% vs. 32.5%; p = 0.009), in the cases and controls, respectively. Data is summarized in Table 3.

Multivariable analysis demonstrated that lumbar spine surgery compared to thoracic and/or cervical spine surgery (OR 13.2 CI 4.0-43.4; p < .001) and surgery performed at > 3 levels (OR 3.9, CI 1.5-9.9; p = .005) are associated with an ileus, controlling for diabetes, gender, and GERD (Table 4).

**Discussion**

Ileus is a relatively rare postoperative complication affecting approximately 5% of patients who undergo posterior spine surgery, causing nausea, emesis, constipation, abdominal bloating and discomfort or even life-threatening complications. Prevention of postoperative ileus has been a long-standing topic for research. Traditional bowel preparation has been routinely utilized in hopes of battling this complication. However, even though bowel preparation may be theoretically

**Table 3.** Bivariable Analysis of Outcome Factors.

	No ileus (n = 80)	Ileus (n = 40)	P-Value
<b>Outcomes (Post Op)</b>			
Nausea	16 (20.0)	17 (42.5)	0,009
Vomiting	5 (6.3)	8 (20.0)	0,022
Constipation	2 (2.5)	8 (20.0)	0,001
Gastroparesis	0 (0.0)	1 (2.5)	0,156
Melena	1 (1.3)	0 (0.0)	0,478
Bowel Obstruction	0 (0.0)	2 (5.0)	0,044
Non-Bowel	23 (28.8)	6 (15.0)	0,097
UTI	2 (2.5)	3 (7.5)	0,196
Vasculary Injury	1 (1.3)	0 (0.0)	0,478
Respiratory Failure/Pneumonia	5 (6.3)	2 (5.0)	0,783
Infeciton	6 (7.5)	1 (2.5)	0,271
TVT	0 (0.0)	1 (2.5)	0,156
<b>Outcomes (PostOP Treatment)</b>			
Laxative	64 (80.0)	38 (95.0)	0,03
Anti Flatulence	11 (13.8)	15 (37.5)	0,003
MCP	0 (0.0)	1 (2.5)	0,156
Histamine 2 Blocker	1 (1.3)	1 (2.5)	0,614
Serotonin Blocker	3 (3.8)	0 (0.0)	0,215
<b>Other</b>			
Delayed Discharge	26 (32.5)	23 (57.5)	0,009
Treatment on ICU	19 (23.8)	15 (37.5)	0,115
Re-Admission	0 (0.0)	2 (5.0)	0,044
Re-Operation for Bowel Issues	0 (0.0)	1 (2.5)	0,156

**Table 4.** Multivariable Analysis of Significant Risk Factors.\*

Ileus	Odds ratio	(95% Conf. interval)	
Major Spine Sugery	3.9	1.5	9.9
Lumbar Spine Surgery	13.2	4.0	43.4

\*Controlling for diabetes, gender, and GERD.

useful, it may also cause other complications such as trauma to the intestinal tissue from inserting the catheter,<sup>11</sup> intolerance for the bowel preparation<sup>12</sup> and increased risk of bowel movement during surgery.<sup>13</sup> Furthermore, Olsen et al reported in a randomized trial no benefit for patients who underwent bowel preparation before spinal fusion surgery. They compared one control group (no bowel preparation) with 2 treatment groups (enema or suppository). Surprisingly, patients who did not receive bowel preparation showed a faster recovery from post-operative constipation.<sup>14</sup> These results are in line with the study by Sasaki et al, which indicates that bowel preparation negatively affects the postoperative gastrointestinal function.<sup>15</sup>

However, while prevention techniques for ileus remains a commonly discussed topic, only a few studies have analyzed risk factors for developing an ileus after spine surgery. Kiely et al reported in their retrospective single-center cohort study (n = 49) several independent risk factors including lactated ringers solution (aOR: 2.12, p < 0.001), 0.9% NaCl solution (aOR: 2.82, p < 0.001), intra-operative hydromorphone (aOR: 2.31, p < 0.01) and GERD (aOR: 4.86, p = 0.03).<sup>16</sup> Al Maaieh et al also reported lateral lumbar interbody fusion (LLIF)

surgery and existing GERD as risk factors for postoperative ileus. Additionally, a prior abdominal surgery has been found to be an independent protective factor for ileus,<sup>17</sup> conflicting other studies suggesting that a history of abdominal operation may in fact be a risk factor for postoperative ileus.<sup>18-20</sup> In our study, neither GERD, nor the history of a previous abdominal surgery, was significantly associated with a postoperative ileus.

The majority of studies analyzing risk factors for a postoperative ileus were able to show that surgical factors such as duration of surgery, selected approach and blood loss might be an important factor in the development of a postoperative ileus.<sup>21,22</sup> Our study did show significant differences between the 2 groups in the length of stay, lumbar surgery and major spine surgery (> 3 level). These results are in line with the study reported by Fineberg et al which identified 7,741 cases of postoperative ileus out of 220 522 lumbar fusions using the NIS (Nationwide Inpatient Sample) data. Their results showed that advanced age and male patients who underwent a major lumbar fusion (> 3 levels) are significant risk factors to develop a postoperative ileus. Furthermore, those patients also expectedly had an increased length of stay and costs.<sup>4</sup> Our study did not demonstrate any significant differences in patient demographics between those who developed postoperative ileus and the control group. Possible explanations for this disparity may lie in the complex and multifactorial etiology underlying postoperative ileus, including mechanical, neurogenic, pharmacological and inflammatory factors.<sup>4,7,17,23,24</sup>

In spite of having been well associated with ileus,<sup>25,26</sup> the current study did not show opioids to be associated with the occurrence of ileus. A major posterior lumbar spine surgery might be a significant risk factor for several reasons. First, extensive surgery results in longer operation time, which requires increased dosing of opioids intra- and postoperatively as pain control management. Second, posterior lumbar surgery may lead to a higher mechanical compression and manipulation of the abdomen compared to thoracic or cervical surgeries.<sup>27</sup> This hypothesis is supported by the fact that patients who underwent a lumbar spine surgery via an anterior approach have a higher likelihood to suffer from a postoperative ileus than patients operated from posterior approaches.<sup>4,6,28</sup>

## Limitations

This study has several limitations. The case control design, despite being an efficient and reasonable design to evaluate risk factors in rare diseases or events,<sup>29,30</sup> may be subject to both selection bias of controls and observation bias of risk factors. As for the control selection, we did not match the control group with respect to preoperative diagnosis, the length of surgery and attempted to minimize this potential bias by selecting controls from the same population during the same time period using a random selection based on a de-identified list (medical record number) in a chronological order. With respect to the selection of risk factors for both cases and controls, these would be considered non-differential since the

selection of cases and controls was subject to the same process and therefore any bias would likely lead to associations in the direction of the null and may explain why we did not identify associations seen in other studies. Due to the retrospective nature of this study several factors cannot be fully assessed. Both groups showed symptoms of nausea, vomiting and constipation, but we were unable to elucidate all causes in the control group. Our results showed that surgical factors such as lumbar surgery and major spine surgery might play an important role in the development of this relatively rare but significant complication, which can lead to a longer length of stay and a higher rate of ICU treatments.

## Conclusion

Postoperative ileus remains a multifaceted complication leading to an increased length of stay and higher overall costs. While prevention of ileus continues to be investigated, little is known and studied about its risk factors, with studies lacking particularly in the spine surgical field. Based on our study, we can state that several risk factors, including gender, age, history of previous abdominal surgery and GERD, are somewhat ambiguous in predicting a postoperative ileus. Conversely, lumbar spine surgery, compared to thoracic and/or cervical spine surgery, and major spine surgery performed at > 3 levels, are associated with postoperative ileus. Further studies are obviously needed to better understand postoperative ileus in spine surgery patients and to further expand on our findings.


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