Incidence and Risk Factors Associated With Ipsilateral Shoulder Pain After Thoracic Surgery

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Objectives: **This study was designed to determine the incidence and risk factors associated with ipsilateral shoulder pain (ISP) after thoracic surgery and to investigate characteristics, locations, and severity of ISP.**

Design: **A prospective observational study.**

Setting: **University hospital.**

Participants: **Two hundred five patients who underwent thoracic surgery.**

Interventions: **None.**

Measurements and Main Results: **Pain at the incisional site and shoulder pain were assessed separately using the numeric rating scale (NRS) during the patients' stay in the postanesthesia care unit. The overall incidence of ISP was 47.3%. The incidence of ISP in thoracotomy patients (58.7%) was substantially higher than in video-assisted thoracoscopic surgery patients (20.9%). ISP was described most often as a dull aching pain (87%). In approximately half of the patients, ISP was located at the posterior side of the shoulder. The severity of ISP was classified as moderate to severe in 67% of patients. The potential risk factors associated with ISP were surgery using the thoracotomy approach (risk ratio: 2.12, 95% confidence interval: 1.16-3.86, $p = 0.014$) and surgical duration >120 minutes (risk ratio: 1.61, 95% confidence interval: 1.07-2.44, $p = 0.023$).**

Conclusions: **The incidence of ISP after thoracic surgery was high and the severity of pain was significant. The thoracotomy approach and the long duration of surgery are potential risk factors for ISP.**

KEY WORDS: shoulder pain, thoracic surgery, thoracotomy, video-assisted, thoracoscopic surgery

IPSILATERAL SHOULDER PAIN (ISP) is a common problem after thoracic surgery, with the reported incidence as high as 85% of patients.[1] Furthermore, its severity also is significant. ISP impairs respiration, mobility, and physical therapy in the early postoperative period.[2] The etiology of ISP is unclear. Several hypotheses have been proposed as possible causes of ISP, including transection of a major bronchus, ligament distraction by surgical retraction, shoulder joint strain as a result of intraoperative positioning, pleural irritation due to the thoracostomy tube, and referred pain from irritation of the pericardium or mediastinal and diaphragmatic surfaces.[1,3,4] The prospective study of large populations to identify risk factors associated with the development of pain will allow increased understanding of the varied causes of this pain. Prospective studies have not been established. The primary objective of this study was to determine the incidence and risk factors associated with ISP after thoracic surgery at a university hospital. The secondary objective was to investigate characteristics, locations, and severity of ISP.

METHODS

This prospective study was approved by the institution's ethics committee. Written informed consent was obtained from all patients. Two hundred five patients, aged 18 to 80 years, who underwent elective thoracotomy or video-assisted thoracoscopic surgery (VATS), were included. Exclusion criteria included presence of preoperative shoulder pain, preoperative shoulder pathology, use of analgesics for more than 1 week preoperatively, inability to understand the numeric rating scale (NRS) scoring system for pain assessment, and failure to extubate at the end of surgery.

All patients received standard monitors. Anesthesia was induced with propofol or thiopental, and tracheal intubation was facilitated with rocuronium, vecuronium or atracurium. Isoflurane or sevoflurane was used for maintenance of anesthesia. Intermittent bolus of fentanyl was used for intraoperative analgesia. The method for treating postoperative pain at the surgical site was determined by the attending anesthesiologist as appropriate.

For patients with thoracic epidural analgesia, only a test dose of 3 mL of 1% lidocaine with epinephrine 1:200,000 was administered via epidural catheter before surgery. At the end of surgery, a bolus dose of epidural solution was given via epidural catheter and followed by a continuous infusion. The drugs used for the epidural solution and the dosage depended on the attending anesthesiologists.

All patients were placed in the lateral decubitus position. A padded roll was placed under the dependent axilla. The upper arm was on an arm rest with 90 degrees of anterior flexion, and the elbow flexed at approximately 60 degrees. All procedures were performed according to a standard surgical technique. At the end of surgery, two chest tubes were inserted, one anterior and the other posterior. Patients having pneumonectomy had only a single chest drain.

During postanesthesia care unit (PACU) stay, an anesthesiologist who was unaware of the surgical and anesthetic details assessed incisional pain and shoulder pain separately using the numeric rating scale (NRS). The characteristics, location, and severity of ISP at rest and during shoulder movement also were assessed.

Sample size (205 patients) was calculated from the relative risk of potential risk factors, such as type of surgery, surgical duration, and surgical approach from the authors' previously collected data, with α error of 0.05 and a power of 90%. Data collected included age, sex, American Society of Anesthesiologists (ASA) physical status, side and type of operation, surgical approach, duration of surgery, and NRS of pain at the incision site and shoulder during PACU stay. All statistical analysis was performed using Stata software (version 11.0, College Station, TX). Categoric data were presented as number and percent, while continuous data were presented as mean and standard deviation (SD). Exact probability test was used to compare categoric variables. Unpaired t test or Wilcoxon rank sum test was used to compare continuous data depending on their distribution. Risk factors of ISP

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Table 1. Demographic and Surgical Data

Variables	No ISP	ISP	p Value
No. of patients	108	97	
Age (years)			0.476
18-40	21 (19.4%)	17 (17.5%)	
40-60	47 (43.5%)	36 (37.1%)	
>60	40 (37.0%)	44 (45.4%)	
mean ± SD	53.5 ± 15.2	56.18 ± 14.1	
Sex			0.974
Male	52 (48.1%)	46 (47.4%)	
Female	56 (51.9%)	51 (52.6%)	
BMI(kg/M^2)	21.5 ± 3.7	21.2 ± 4.2	0.518
ASA physical status			0.741
1-2	92 (85.2%)	81 (83.5%)	
3-4	16 (14.8%)	16 (16.5%)	
Surgical duration(minutes)			<0.001
≦120	63 (58.3%)	23 (23.7%)	
>120	45 (41.7%)	74 (76.3%)	
mean ± SD	129.3 ± 55.0	167.8 ± 65.2	
Surgical approach			<0.001
Thoracotomy	59 (54.6%)	84 (86.6%)	
VATS	49 (45.4%)	13 (13.4%)	
Type of surgery			<0.001
Pneumonectomy	0	2 (2.1%)	
Lobectomy	45 (41.7%)	63 (64.9%)	
Segmentectomy+wedge +biopsy	55 (50.9%)	28 (28.9%)	
Others	8 (7.4%)	4 (4.1%)	
Side of surgery			0.094
Right	66 (61.1%)	70 (72.2%)	
Left	42 (38.9%)	27 (27.8%)	

Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index; ISP, ipsilateral shoulder pain; SD, standard deviation; VATS, video-assisted thoracoscopic surgery.

were analyzed using univariate and multivariate binary regression with robust estimates to calculate risk ratio (RR) and their 95% confidence interval. A manual stepwise forward logistic regression was used to extract univariate independent variables. A p value ≤0.2 by univariate analysis was used as the criterion for choosing variables to be included in the model for multivariate analysis. A p value <0.05 was considered statistically significant. Cut-off points of the independent variables, including age group and duration of surgery, were estimated by the method of maximum likelihood to achieve best discrimination between patients with and without ISP.

RESULTS

A total of 205 patients were enrolled in this study, among whom were 143 patients undergoing surgery through thoracotomy and 62 patients through VATS. The demographic and surgical data of the patients with and without ISP were comparable (Table 1). Type of surgery stratified by surgical approach is shown in Table 2. The overall incidence of postoperative ISP was 47.3%. The incidence of ISP in thoracotomy patients (58.7%) was substantially higher than in VATS patients (20.9%). The incidence of ISP with different severity stratified by surgical approach is shown in Figure 1. The characteristics, location, and severity of ISP are shown in Table 3. In 62% of patients with ISP, pain was aggravated with shoulder movement.

The mean surgical duration of thoracotomy and VATS was 169.9 ± 56.9 minutes and 94 ± 37.4 minutes, respectively.

Table 2. Type of Surgery Stratified by Surgical Approach

Type of operation	Thoracotomy (n = 143)	VATS (n = 62)
Pneumonectomy	2 (1.4)	–
Lobectomy	106 (74.1)	2 (3.2)
Segmentectomy+wedge+biopsy	30 (21.0)	531 (85.5)
Others	5 (3.5)	7 (11.3)

NOTE. Data are presented as number (%).
Abbreviation: VATS, video-assisted thoracoscopic surgery.

The mean surgical duration of patients with ISP was significantly longer than those without ISP in thoracotomy (180.7 ± 58.5 minutes *v* 156.3 ± 53.1 minutes, p = 0.012) but not in VATS (83.8 ± 39.1 *v* 96.7± 36.9 minutes, p = 0.273).

The thoracotomy approach, duration of surgery >120 minutes, and major thoracic procedures, including pneumonectomy and lobectomy, increased the risk of ISP by univariate risk regression (Table 4). From the multivariate risk regression, the risk factors of ISP were surgery with thoracotomy approach and duration of surgery >120 minutes (Table 5).

There was no statistically significant difference in the mean dose of intraoperative fentanyl between patients with and without ISP (100 ± 46.5 *v* 95.4 ± 31.1 μg, p = 0.429).

For the postoperative pain control at incisional site, thoracic epidural analgesia was performed in 64% (92/143) of thoracotomy patients and 1.6% (1/62) of VATS patients. Paravertebral nerve block was performed in 18% (26/143) of thoracotomy patients and 50% (31/62) of VATS patients. Seventy-three percent of patients who had effective epidural analgesia (no-to-mild incisional pain) developed ISP. In addition, 53% of patients who had no incision pain developed ISP.

DISCUSSION

The present study's results confirmed that ISP after thoracic surgery is a considerable problem. Previous studies reported that the incidence of ISP after thoracotomy varied from 31% to 85%.[1,5–11] The wide range of these incidences might be related to the differences in surgical and anesthetic technique of each institution. The severity of ISP after thoracotomy usually was described as moderate to severe,[3,12–14] similar to the findings in this study.

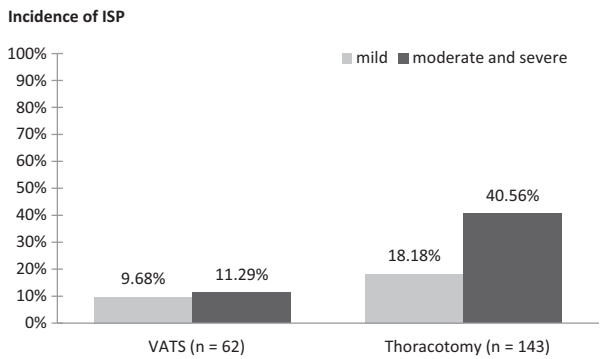

Fig 1. Incidence of ISP during postanesthesia care unit stay stratified by surgical approach.