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Time Characteristics of Shoulder Pain after Laparoscopic Surgery

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ABSTRACT

Objective: To explore the time characteristics of shoulder pain after laparoscopic gynecological operation.

Methods: We conducted prospective clinical observations and literature review. We studied 442 cases of laparoscopic gynecological surgery. We used a visual analogue scale to evaluate the pain of patients at different time points after operation. We searched the English literature of shoulder pain after gynecological laparoscopic surgery. The observation time points of these studies included 12–24 hours or the first day after surgery, and at least one time point before this time point.

Results: The total incidence of shoulder pain was 68%. More than 90% of patients begin to feel shoulder pain on the first day after surgery, not on the day of surgery. 26 articles observed the severity of postlaparoscopic shoulder pain (PLSP) at different time points, of which 17 articles found that the intensity of the shoulder pain peaked at 12–24 hours or the first day after operation.

Discussion: The occurrence of PLSP presents obvious time characteristics. The incidence and severity of PLSP peaked on the first day or 12–24 hours after operation. To prevent and treat PLSP better, clinicians should make a more in-depth study according to the time characteristics of PLSP.

Key Words: Shoulder pain, Laparoscopy, Temporal characteristics.

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INTRODUCTION

Minimally invasive is one of the principles of modern surgery. In recent surgical practice, laparoscopy is replacing conventional laparotomy because of several of its advantages. Over 8000 laparoscopic operations are performed in our hospital every year. A substantial number of patients complain of postlaparoscopic shoulder pain (PLSP), which can be more uncomfortable than abdominal incisional and visceral pain after surgery.[1] To prevent and treat it better, it is necessary for clinicians to understand its characteristics.

MATERIALS AND METHODS

This study was reviewed and approved by the Institutional Review Board and was registered with the Chinese Clinical Trial Registry.

We studied 442 inpatients (ASA level I) that underwent elective gynecological laparoscopic surgery. Exclusion criteria included chronic pain syndromes such as fibromyalgia or neck and shoulder pain, history of long term use of daily opioids, allergies to medications used in this study (such as fentanyl, propofol, midazolam), impaired cognitive function or inability to understand the study protocol, communication barriers, unstable cardiovascular disease and hypertension, central nervous system disease, endocrine system diseases, and liver and kidney dysfunction.

All patients received similar general anesthetic and surgical regimens. No premedication was used. Heart rate, arterial blood pressure, and oxygen saturation were monitored in all patients on arrival at the anesthetic room. General anesthesia was induced with midazolam (0.1 mg/

kg), fentanyl (4 μg/kg), and propofol (1–2 mg/kg). Cisatracurium infusion was used to facilitate tracheal intubation (0.15 mg/kg) and obtain intraoperative muscle relaxation. Anesthesia was maintained with oxygen in air (1:2), sevoflurane, propofol, and remifentanil. Minute ventilation was adjusted in accordance with the arterial CO_2 pressure in the exhaled air ($PetCO_2$). Ondansetron (8 mg) was administered intravenously by anesthesiologists to minimize postoperative nausea and vomiting when the surgeons began to close the umbilical trocar sites. At the end of surgery, neuromuscular relaxation was reversed pharmacologically using atropine and neostigmine.

All patients were set in the lithotomy position and trendelenburg position during the operation. Laparoscopy was performed with abdominal insufflation of CO_2 (unheated, unhumidified) at 12-mm Hg using a standard automated insufflator. All operations were conducted by experienced laparoscopic surgeons using the standard technique with one 10-mm and two 5-mm trocars. The CO_2 was evacuated at the end of the procedure by manual compression of the abdomen with open trocars. All patients were kept for observation in the PACU until their condition was stabilized before shifting them to their designated wards.

The following prophylactic analgesic standard treatment was used: intravenous propacetamol (1 g) was used approximately 20 min before the end of surgery, and either intravenous pentazocine (30 mg in the PACU) or orally ibuprofen sustained release capsules (300 mg in the ward) were administered on demand.

All patients were assessed with visual analogue scale (VAS). We evaluated the shoulder pain before the patients left the PACU and at 6, 12, 24, 48, and 72 hours after surgery.

The review has been performed by a search on PubMed, Medline, and OVID with the key words: “shoulder pain”, “laparoscopy”, “laparoscopic surgery”, “gynecologic surgery”, “gynecology”, “endoscopic”, “pain”, and “postoperative pain”. We only searched English literatures published before Jun 2020.

RESULTS

Because of the tumor or serious abdominal adhesion, 4 patients changed to open surgery. One case underwent emergency operation due to postoperative abdominal hemorrhage. The 437 patients completed the study. Baseline characteristics of the 437 patients are shown in **Table 1**. Our study showed a 68% (297/437) incidence of PLSP. Over 90% of these patients developed shoulder pain on the first day after surgery.

Table 1.
Demographic and Clinical Characteristics of Postlaparoscopic Shoulder Pain in 437 Study Patients

	Data
Age (years)	34.5 (21–58)
Body mass index (kg/m^2)	23.7 (15.7–34.8)
Operation time (min)	90 (20–235)
Anesthesia	General anesthesia with tracheal intubation
Type of laparoscopy	
Diagnostic	128 (29.3)
Coagulate endometriosis	37 (8.5)
Adhesiolysis	58 (13.3)
Ovarian cystectomy	42 (9.6)
Tuboplasty	49 (11.2)
Myomectomy	38 (8.7)
Salpingectomy	39 (8.9)
Combined	46 (10.5)
VAS score	
Before patients left PACU	0.00 ± 0.00
6 h	0.00 ± 0.00
12 h	1.32 ± 1.92
24 h	2.62 ± 2.28
48 h	1.69 ± 2.02
72 h	0.83 ± 1.52

Data are presented as means [interquartile range], mean ± SD or numbers (%).

We only looked at the literature on the incidence and (or) severity of shoulder pain at different time points after operation, rather than the literature with only one observation time point. We screened 41 articles. Twenty-seven of them met our requirements.[2–28] The observation time points of these studies included 12–24 hours or the first day after operation, and at least one time point before this time point. Seven of them observed the incidence of PLSP at different times, and five reported that the incidence of PLSP peaked at 24 hours after operation (**Table 2**). Two

Table 2.
Systematic Review of the Literature

Author		Patients n	Incidence of Shoulder Pain (%)									
			1 h	2 h	3 h	4 h	6 h	8 h	12 h	24 h	48 h	Overall
	LTV group	28		21.4		39.3				46.4[a]	32.1	57.1
Liu[2]	Total	60				11.7		30	35	36.6[a]	20	
	Group 1	30										86
	Group 2	30										67
Kerimoglu[3]	Total	93										
	Drain group	44					63.6[a]			43.6		
	No-drain group	49					67.8[a]			48.2		
Abbott[4]	Total	161										
	Placebo group	79				24				34[a]	20	
	Drain group	82				12				23[a]	8	
Bogani[5]	Total	42										
	LPP group	20	5		10					5		
	SPP group	22	36		41[a]					5		
Sharami[6]	Total	131				54.2				58[a]	48.9	58
	Control group	64										
	Intervention group	67										
Shen[7]	Total	164										
	Drains group	80			11					23[a]	9	
	No-drains group	84			20					40[a]	21	
Zhang[8]	Total	123					Rest/motion					54
	Group C	42					12.3/28.6			40.5/57.1[a]	12.3/38.1	61.9
	Group M	40					7.5/22.5			17.5/37.5[a]	10/17.5	37.5
	Group S	41					12.2/19.5			22/58.5[a]	12.2/37.1	61

Values are meant as median (SD) unless indicated otherwise.
Overall: the total incidence of PLSP during postoperative observation (in each group, the number of patients with VAS = 0 at each time point was recorded to evaluate the overall incidence of PLSP); LPP group: low pneumoperitoneum pressure group; SPP group: standard pneumoperitoneum pressure group.
[a]The patient's shoulder pain reached its peak.

articles did not provide the incidence of shoulder pain at different time points in the control group and the intervention group. 100% (5/5) of the studies found that the intervention did not change the time characteristics of shoulder pain incidence. Among them, 26 articles observed the severity of PLSP at different time points. A total of 55 groups were observed. The shoulder pain of 30 groups reached the peak at 12–24 hours or the first day after operation (**Table 3**, **Table 4**). Although the interventions in these studies were statistically significant compared to the control group, 70.8% (17/24) of the studies found that the intervention did not change its time characteristics based on the study of shoulder pain severity.

DISCUSSION

Laparoscopic surgery has obvious advantages in the diagnosis and treatment of gynecological diseases. Minimally invasiveness is one of the most important characteristics of laparoscopic surgery. Minimally invasive surgery does not mean only a small incision. The patients hope that after laparoscopic surgery, the pain will be relieved, the requirement of analgesia will be reduced, the length of hospital stay will be shortened, the recovery of activity will be early, and the incidence of complications will be reduced.[1,29] Most of these advantages are achieved by reducing pain after surgery.

Table 3.
Systematic Review of the Literature

Author	Patients N		Representation of data	Intensity of Shoulder Pain after Laparoscopy (PLSP)											
				1 h	2 h	3 h	4 h	6 h	8 h	12 h	16 h	24 h	36 h	48 h	Overall
Kerimoglu[3]															
Total	93	VAS	Mean (SD)												
Drain group	44							2.7[a] (1.7)				0.9 (1.1)			
No-drain group	49							2.4[a] (1.6)				0.8 (0.8)			
Abbott[4]															
Total	161	VAS	Mean												
Placebo group	79						34					44[a]	26		
Drain group	82						30					40[a]	26		
Bogani[5]															
Total	42	VAS	Mean (SD)												
LPP group	20			0.8 (3.5)		1.1[a] (3.7)						0.5 (2.4)			
SPP group	22			5.0 (7.3)		8.2[a] (12.7)						0.5 (2.5)			
Sharami[6]															
Total	131	VAS	Mean (SD)												
Control group	64						3.6[a] (3.5)			3.4 (2.9)		2.6 (2.4)		1.5 (1.6)	
Intervention group	67						1.28[a] (1.7)			1.19 (1.7)		0.89 (1.3)		0.46 (0.72)	
Shen[7]															
Total	164	VAS	Mean (SD)												
Drains group	80					0.8 (0.6)						2.2[a] (1.1)		1.5 (1.0)	
No-drains group	84					0.9 (0.7)						3.8[a] (1.3)		2.5 (1.2)	
Phelps[9]															
Total	100	VAS	Mean (SD)												
Control group	46									30.3[a] (4.5)		25.7 (4.7)	21.7 (4.3)	—	
Intervention group	54									15.6[a] (3.0)		10.8 (2.4)	9.1 (2.5)	—	
Chaichian[10]	12	VAS	Mean (SD)				0.8[a] (1.7)			0.8 (1.5)		0.3 (0.8)		0.1 (0.3)	
			Median (range)				0 (0–6)			0 (0–5)		0 (0–2)		0 (0–1)	
Swift[11]															
Total	67	VAS	Median (range)												
Blocked gas drain group	30						0 (0–6)			3.25[a] (0–9)		3 (0–8)		1.5 (0–7)	
Patent gas drain group	37						0 (0–9)			0 (0–9.5)		0 (0–9)		0 (0–8.5)	
Sroussi[12]															
Total	60	NRS	Mean (range)												
AirSeal 7 mm Hg group	30						0.8[a] (0–7)		0.7 (0–7)			0.5 (0–6)			
Standard 15 mm Hg group	30						2.1 (0–8)		2.6[a] (0–10)			1. (0–6)			

Table 3. Continued

Author	Patients N		Representation of data	Intensity of Shoulder Pain after Laparoscopy (PLSP)											
				1 h	2 h	3 h	4 h	6 h	8 h	12 h	16 h	24 h	36 h	48 h	Overall
Valadan[13]															
Total	40	VAS	Mean (SD)												
Placebo group	20				4.5[a] (3.5)			4.3 (3.2)		3.4 (2.9)					
Gabapentin group	20				1.7 (1.8)			2.8[a] (2.9)		1.6 (2.2)					
Leelasuwattanakul[14]															
Total	74	VAS	Median (min-max)												
Control group	37							4.2[a] (2–8.8)		3.5 (2.0–8.3)		2.1 (1.5–8.5)			
Study group	37							0.2[a] (0–7)		0 (0–8)		0 (0–7.5)			
Herrmann[15]															
Total	97	VAS	Mean Median (range)												
Control group	49				0.65 0 (0–8.7)		0.23 0 (0–3.6)	0.45 0 (0–7.2)				1.61 0 (0–10)		1.62[a] 0.1[*] (0–10)	
Intervention group	48				0.13 0 (0–2.7)		0.21 0 (0–5.4)	0.09 0 (0–2.4)				1.24[*] 0 (0–8.3)		1.23 0 (0–8.4)	
Radosa[16]															
Total	289	NRS	Mean (SD)												
Control group	96					2.23 (1.52)						5.14[a] (1.49)		4.22 (1.43)	
EAV group	98					2.18 (1.39)						4.28[a] (1.51)		3.64 (1.66)	
EAV and TSI group	95					2.52 (1.38)						4.15[a] (1.48)		3.72 (1.64)	
Hoyer-Sorensen[17]															
Total	40	VAS	Median												
Conventional group	20							0.6 (IQR0)				1.4[a] (IQR2)			
LESS group	20							2.4 (IQR5)				3.1[a] (IQR4)			4.73 1.6 (0–24.4)
Bunyavejchevin[18]															
Total	60	VAS	Mean (SD) Range												2.62 0.35[*] (0–11.2)
Control group	30				2.0 (1.6) 1.6–2.8			4.5 (1.7) 4.0–5.1		4.5[a] (2.0)3.9–5.2		3.7 (1.8) 3.2–4.3			

Table 3. Continued

Author	Patients N		Representation of data	Intensity of Shoulder Pain after Laparoscopy (PLSP)											
				1 h	2 h	3 h	4 h	6 h	8 h	12 h	16 h	24 h	36 h	48 h	Overall
Treatment group	30				0.7 (1.2) 0.2–1.2			1.6[a] (1.5) 1.2–2.3		1.1 (1.3) 0.6–1.7		0.7 (1.1) 0.3–1.2			
Chou[19]															
Total	79	VAS	Mean (SD)												
Group A	26				0.33 (0.84)		0.50 (1.29)		0.83[a] (2.00)		0.56 (1.29)				
Group B	26				0.32 (0.84)		0.55 (1.22)		0.64[a] (1.14)		0.64 (1.18)				
Group C	27				0.53 (1.23)		1.58[a] (2.82)		1.21 (1.99)		1.68 (2.79)				
Narchi[20]															
Total	65	VAS	Mean (SD)	Time 0											
Control group	15			1.14 (2.22)					4.13[a] (2.83)	4.01 (2.75)		2.42 (2.54)	2.75 (3.2)	1.43 (2.01)	
Saline group	15			2.03 (2.76)					3.5[a] (3.32)	3.4 (2.95)		3.4 (3.07)	2.40 (1.88)	1.1 (1.45)	
Lignocaine group	20			0.92 (2.38)					1.58 (1.99)	1.59[a] (1.85)		1.27 (1.96)	0.83 (1.86)	0.31 (0.74)	
Bupivacaine group	15			0.66 (1.23)					1.64 (2.17)	1.86[a] (2.58)		1.3 (1.27)	1.37 (1.74)	0.54 (0.99)	
Ghezzi[21]															
Total	76	VAS	Mean (SD) Median (range)												
LH group	38			0.8[a] (1.9) 0 (0–7)		0.5 (1.7) 0 (0–7)			0.7 (1.8) 0 (0–7)			0.6 (1.9) 0 (0–10)			
MLH group	38			1.0[a] (1.9) 0 (0–7)		0.8 (2.1) 0 (0–5)			0.6 (1.1) 0 (0–3)			0.7 (1.5) 0 (0–6)			
Asgari[22]															
Total	84	VAS	Mean (SD)								Prior to dischage				
Group 1	28				5.18 (3.66)		4.69 (3.01)	4.66 (3)		4.36 (3.11)	3.3 (2.18)				
Group 2	28				3.07 (3.4)		3.38 (3.16)	4.19 (3.13)		4.96[a] (3.09)	3.65 (2.69)				
Group 3	28				4.34 (3.58)		4.15 (3.04)	5.14[a] (3.02)		3.96 (2.59)	2.62 (1.82)				
Tharanon[23]															
Total	45														
Control group	22							—				—[b]		—	

Table 3. Continued

Author	Patients N	Representation of data	Intensity of Shoulder Pain after Laparoscopy (PLSP)									
			1 h	2 h	3 h	4 h	6 h	8 h	12 h	16 h	24 h	36 h	48 h	Overall
Intervention group	23						—				[b]		—	
Liu[2]														
Total	60	NRS												
Group 1	30			—		—		—	—		[b]		—	
Group 2	30			—		—		—	[b]		[b]		—	
Jong Bum Choi[24]	50	VAS	—		—		—				[b]		—	

Values are meant as median (SD) unless indicated otherwise.
LPP group: low pneumoperitoneum pressure group; SPP group: standard pneumoperitoneum pressure group. VAS: visual analogue scale; NRS: numerical rating scale.
[a]The patient's shoulder pain reached its peak.
[b]Unable to determine the exact value from the original text.

However, the pain after laparoscopic surgery has not been completely eliminated. Many patients may feel shoulder pain, which is more uncomfortable than abdominal incision and visceral pain, and is rarely seen in traditional laparotomy. Because most patients think shoulder pain has nothing to do with surgery, it makes them more anxious. This may lead to discomfort and poor quality of life after laparoscopic surgery, and greatly reduce patient satisfaction. Therefore, this will not be conducive to highlighting the advantages of laparoscopic surgery.

As far as we know, many interventions and comparative studies on reducing shoulder pain after gynecological laparoscopic surgery have been documented in the British literature so far. Our clinical observations and many previous studies have shown that the temporal characteristics of shoulder pain after gynecological laparoscopic surgery are significantly different from those of incision and visceral pain after surgery. Visceral and incision pain was more severe on the day after operation, and then gradually reduced. However, PLSP began to become serious in 12–24 hours (or the first day after operation). More importantly, most clinical studies have found that almost all interventions do not change the temporal characteristics of shoulder pain after laparoscopic gynecologic surgery.

Although the specific mechanism of PLSP is still controversial, most scholars believe that it is caused by the stimulation of the phrenic nerve by residual gas in the abdominal cavity after operation. In our hospital, all our patients began to get out of bed on the first day (12–24 hours) after surgery. Most of the patients began to have shoulder pain after getting out of bed for the first time. It may be that the location of gas accumulation in the abdominal cavity changes with body position, and then cause shoulder pain.

In addition, among all kinds of pain after laparoscopic surgery, shoulder pain has the least response to nonsteroidal anti-inflammatory drugs or opioid analgesics. Although morphine can control other types of pain, such as incision and visceral pain, it cannot effectively control PLSP. This may be related to the unreasonable timing of our medication.[30,31] We should choose the administration scheme that matches the temporal characteristics of PLSP.

Clinical and Research Implications

The results show that shoulder pain after gynecological laparoscopic surgery has obvious temporal characteristics,

Table 4.
Systematic Review of the Literature

Author	Patients N	Representation of Data Mean (SD)	Intensity of Shoulder Pain after Laparoscopy (PLSP)									
			Arrival	2 h	4 h	6 h	8 h	Discharge	Day 0	Day 1	Day 2	Day 3
Korell[25]												
Total	89											
Cold gas	45					3.2 (2.6)				3.6[a] (2.4)	2.7 (2.1)	1.8 (1.9)
Warm gas	44					3.2[a] (2.6)				2.5 (2.6)	1.7 (2.3)	1 (1.6)
Suginami[26]												
Total	40											
Group I	19								—	PM-[b]	—	—
Group II	21								—	—	AM-[b]	—
Madsen[27]												
Total	99											
Group 8-deep	49		—		—	—		—[b]	—	—	—	—
Group 12-Mod	50		—		—	—		—[b]	—	—	—	—
Goldberg[28]												
Total	51											
CO_2 group	29		—					—		—[b]	—	—
Gasless group	22		—					—		—[b]	—	—

[a]The patient's shoulder pain reached its peak.
[b]Unable to determine the exact value from the original text.

which is significantly different from incision and visceral pain after laparoscopic surgery. Clinicians should be familiar with the time characteristics of its occurrence. To fully highlight the advantages of laparoscopic surgery, a multifactor approach may be needed to solve PLSP in future research. This method needs to fully consider the temporal characteristics of PLSP.

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