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Laparoscopic procedures-induced keloids: A retrospective case series study

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Abstract

The abdominal skin is not a common area for keloid formation. The knowledge of laparoscopically induced keloids (LIK) remains little. This article aimed to review the case series of LIK and analyse the characteristics. A retrospective and descriptive study was conducted. Patients' clinical records in the database were collected, including the demographics, medical history, laparoscopic surgery information, keloid information, and the severity of LIKs recorded using the Patient and Observer Scar Assessment Scale. Twenty-four LIK patients were enrolled. 18 patients were female and 10 had chronic diseases. 11 patients had non-LIKs. 91.6% patients received laparoscopic cholecystectomy. LIKs were mainly located under the xiphoid process (N = 20), followed by the umbilicus (N = 16). 41.7% patients developed keloids at all trocha sites. The severity of the LIK was significantly negatively associated with the presence of the non-LIK. Laparoscopic procedures could lead to the formation of keloids. Two types of LIKs were noticed: extended incisions induced long "spreading" type and trocha induced round bulging type. The presence of non-LIKs could significantly reduce the severity of LIKs.

KEYWORDS

keloid, laparoscopic surgery, trocha, umbilicus

Key Messages

- the abdominal skin is not a common area for keloid formation
- the knowledge of laparoscopically induced keloids remains little
- thereby we conducted a retrospective and descriptive study to review the case series and analyse the characteristics
- this article complements the current lack of knowledge about laparoscopically induced keloids
- this article introduces the characteristics of laparoscopically induced keloids and reveals that the presence of non-laparoscopically induced keloids could significantly reduce the severity of laparoscopically induced keloids

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1 | INTRODUCTION

Keloids constitute an abnormal fibroproliferative wound healing response in which raised scar tissue grows excessively and invasively beyond the original wound borders, resulting in apparent cosmetic disfigurement, itching and pain, and impairment in quality of life and mental health.[1] The pathogenesis of keloids is complex and still uncertain. The location of the wound influences the risk of keloid formation as certain sites are more prone to keloid formation, such as the earlobe, neck, sternum, upper back, shoulders, and upper limbs.[1-3]

Laparoscopic surgery is a relatively minimally invasive surgical method that avoids large open abdomens and can provide patients with rapid recovery, less pain, and less surface trauma and scarring, so the public increasingly favours it.[4]

The abdominal skin is not a common area for keloid formation.[5] The keloids caused by minimally invasive laparoscopy are rare with a few case reports.[6,7] The knowledge of laparoscopically induced keloids (LIK) remains little. This article aimed to review the case series of LIKs and analyse their characteristics.

2 | MATERIALS AND METHODS

A retrospective and descriptive study was conducted with ethical approval obtained from the institutional committee of the corresponding authors. All rules of confidentiality and anonymity were upheld. This work has been conducted in accordance with the CARE criteria.[8,9] It was carried out using medical records obtained from 2012 to 2021. The clinic database was used to identify all the patients seen in the study period who were diagnosed with keloid. Patients with keloids resulting from laparoscopic surgery were enrolled in the study.

Patients' clinical records in the database were examined to collect the demographics (including age, gender), medical history (chronic disease, surgical history), laparoscopic surgery information (trocha site, number), and keloid information (onset, course, site, symptoms, signs, treatment). The severity of LIKs was described by the results of the Patient and Observer Scar Assessment Scale (POSAS)[10] recorded in the database.

2.1 | Statistical analysis

Statistical analyses were conducted using SPSS 26.0 (IBM, USA). Shapiro–Wilk test was used to assess continuous variables for normality. Independent *t*-test was used to assess normally distributed continuous variables and the results are presented as mean and standard deviation. Categorical variables were assessed using the chi-square test and results are presented as numbers and percentages. Multivariate regression analysis was used to explore the association between the factors and trocha keloid severity. Significance was set to the level of $P < .05$.

TABLE 1 Descriptive information

Subject	Number of patients
Number	24
Female	18
Male	6
Age (year)	60.33 ± 13.46
Chronic diseases	10
Hypertension	5
Diabetes	3
Coronary heart disease	2
Hyperlipidemia	1
Surgery history	10
Appendectomy	2
Thyroid cancer surgery	1
Lumbar spine surgery	2
Breast cancer surgery	1
Liposuction	1
Open liver surgery	1
Hysterectomy	3
Caesarean section	1
Brain surgery	1
Non-laparoscopically induced keloids	11
Chest	4
Earlobe	1
Breast	2
Abdomen	5
Perineum	1

3 | RESULTS

Twenty-four LIK patients met the inclusion criteria and were enrolled in the study, whose average age was 60.33 ± 13.46 years (Table 1; Figure 1). Eighteen (75%) patients were female. Ten (41.7%) patients had chronic diseases, including hypertension, diabetes, coronary heart disease, and hyperlipidemia. Ten (41.7%) patients had undergone

FIGURE 1 Examples of laparoscopically induced keloids (LIKs). Extended incision-induced LIK presented long spreading below the xiphoid process, and trocha-induced LIKs presented round bulging on the umbilicus and the lower abdomen.

other surgeries, including appendectomy, thyroid cancer surgery, lumbar spine surgery, breast cancer surgery, liposuction, liver surgery, hysterectomy, caesarean section, and brain surgery. Eleven (45.8%) patients had non-LIKs at the chest, earlobe, breast, abdomen, and perineum sites. It was worth noting that several patients have undergone appendectomy and lumbar fracture surgery with satisfying scarring wound healing, but the laparoscopic trocha site left keloids.

In terms of laparoscopic surgery, 91.6% (N = 22) of the patients received laparoscopic cholecystectomy (Table 2). Nine (37.5%) cases had an extended incision on the trocha site. LIKs were mainly located under the xiphoid process (N = 20), followed by the umbilicus (N = 16). Ten (41.7%) patients developed LIKs at all trocha sites. The mean time to keloid appearance was 1.07 ± 0.31 years postoperatively. The average duration of LIKs for the patients was 8.35 ± 5.10 years. The severity of LIK in each individual was measured by the most severe one. The average POSAS scores were: Observer 22.13 ± 4.13, Patient 19.92 ± 7.96, and Combined 42.04 ± 11.70. Twenty-two patients underwent keloid excision surgery and postoperative adjuvant radiotherapy (performed by the radiotherapy department). Postoperative pathology confirmed keloids in these patients, and four of the patients had epidermoid cysts or chronic inflammation.

Three patients experienced the recurrence of keloids after resection within one year. One patient was lost to follow-up.

Patients were separated into two groups according to whether LIKs were present in all trocha sites. Then the severity of the LIKs in the two groups was compared: there was a significant difference in the Observer and Combined scores ($P = .045$, $P = .047$) and no difference in the Patient scores ($P = .060$) (Table 3). Patients were then separated into two groups according to the presence or absence of non-LIKs. It was found that patients without non-LIKs had significantly higher severity than those with non-LIKs ($P = .023$; $P = .041$; $P = .028$). Patients were grouped according to the course of LIKs, and no difference in severity was found between the two groups (course ≤8 years, and >8 years).

Multiple linear regression showed that the severity of the LIKs (POSAS Observer, Patient, Combined) was significantly negatively associated with the presence of the non-LIKs (OR: −4.801, 95% CI: −8.184 ~ −1.419, $P = .017$; OR: −9.319, 95%CI: −16.273 ~ −2.366, $P = .022$; OR: −14.121, 95% CI: −23.847 ~ −4.394, $P = .015$) (Table 4).

4 | DISCUSSION

Keloid, a benign fibroproliferative tumour originating in response to trauma to the skin, is characterised by an overabundant accumulation of extracellular matrix components, such as collagen, in the dermis and subcutaneous tissue that extends beyond the confines of the original wound site.[11] The exact aetiology of keloid formation remains unknown. Various abnormalities have been reported in keloid tissues that contribute to the expression of abnormal cellular responses: patient factors (ethnicity, genetics, age, hormones), topography factors (tension, sebaceous glands, viscoelasticity), and unique skin sites (injury, inflammation).[1] Certain body sites are more prone to keloid formation, such as earlobes, shoulders, necks, anterior chests, upper backs, and upper limbs; thus, the location of the wound influences the risk of keloid formation.[1,3] There may be several factors of

TABLE 2 The information on laparoscopic surgeries and laparoscopically induced keloids

Subject	Number (Percentage)
Type of surgery	
Laparoscopic Cholecystectomy	22 (91.7%)
Laparoscopic Hysterectomy	2 (8.3%)
Trocha number	
3	14 (58.3%)
4	10 (41.7%)
Extended incision case	9 (37.5%)
Sutured the trocha wound	24 (100%)
Trocha wound healing	
Primary	22 (91.7%)
Secondary	2 (8.3%)
LIKs on trocha sites	
Xiphoid process	20
Umbilicus	16
Right upper quadrant	7
Lower abdomen	7
LIKs presented in all trocha sites	10 (41.7%)
Time of LIK onset (years post-operation)	1.07 ± 0.31
LIK Course (years)	8.35 ± 5.10
Severity of LIKs	
POSAS Observer	22.13 ± 4.13
POSAS Patient	19.92 ± 7.96
POSAS Combined	42.04 ± 11.70
Treatment	
Resection+ radiotherapy	22 (91.7%)
Untreated	2 (8.3%)
Pathology	
Keloid	18 (81.8%)
Keloid with epidermoid cyst/chronic inflammation	4 (18.2%)
Recurrence	
Yes	3 (13.6%)
No	18 (81.9%)
Lost to follow-up	1 (4.5%)

Abbreviation: LIK, Laparoscopically induced keloids.

TABLE 3 The differences between the patients with and without non-laparoscopically induced keloids were compared

Item	Patients without non-LIK	Patients with non-LIK	*P* value
Number	13 (54.2%)	11 (45.8%)	.193
Female	9 (69.2%)	10 (90.9%)	
Male	4 (30.8%)	1 (9.1%)	
Age (year)	59.15 ± 15.63	61.73 ± 10.95	.651
Chronic diseases			.729
Yes	5 (38.5%)	5 (45.5%)	
No	8 (61.5%)	6 (54.5%)	
Delayed wound healing			.174
Yes	2 (15.4%)	0	
No	11 (84.6%)	11 (100%)	
Time of onset	1.12 ± 0.42	0.95 ± 0.15	.238
Course (years)	8.00 ± 4.34	8.64 ± 5.89	.764
Whether LIKs were present in all trocha sites			.628
Yes	6 (46.2%)	4 (36.4%)	
No	7 (53.8%)	7 (63.6%)	
Keloid with epidermoid cyst/chronic inflammation			.855
Yes	2 (15.4%)	2 (18.2%)	
No	11 (84.6%)	9 (81.8%)	
Severity of LIKs			
POSAS Observer	23.85 ± 4.52	20.09 ± 2.51	.023
POSAS Patient	22.69 ± 9.10	16.36 ± 4.54	.041
POSAS Combined	46.77 ± 13.33	36.45 ± 6.20	.028
Surgical treatment			
Yes	12 (92.3%)	10 (90.9%)	.902
No	1 (7.7%)	1 (9.1%)	
Recurrence			.146
Yes	3 (25.0%)	0	
No	9 (75.0%)	9 (90.0%)	
Lost follow-up	0	1 (10.0%)	

Abbreviation: LIK, Laparoscopically induced keloids.

body location that increase the risk of keloid formation. These areas may be more prone to trauma or inflammatory disease (eg, with the presence of high sebaceous gland density).[11] The second is that these are regions of increased skin tension subject to constant stretching during normal movement.[12] Increased elasticity may also promote keloid formation, but this theory remains controversial.[1,13] The abdomen is generally not considered the place most prone to keloid formation.

Laparoscopic surgery is increasingly popular among patients with it leaves a strong impression on the public

TABLE 4 Analysis of influencing factors of the severity of the laparoscopically induced keloid

	POSAS Observer			POSAS Patient			POSAS Combined		
Characteristic	**Coefficient**	**95% CI**	***P***	**Coefficient**	**95% CI**	***P***	**Coefficient**	**95% CI**	***P***
Age	0.143	−0.041 ~ 0.326	.153	0.240	−0.138 ~ 0.617	.237	0.382	−0.145 ~ 0.910	.181
Gender	−1.783	−6.203 ~ 2.637	.445	−4.023	−13.109 ~ 5.064	.403	−5.805	−18.515 ~ 6.904	.388
Chronic diseases	−2.532	−6.558 ~ 1.493	.241	−7.515	−15.791 ~ 0.761	.100	−10.048	−21.624 ~ 1.528	.115
Surgery history	−1.405	−4.805 ~ 1.994	.434	−0.216	−7.205 ~ 6.773	.953	−1.621	−11.397 ~ 8.154	.751
Non-LIKs	−4.801	−8.184 ~ −1.419	.017	−9.319	−16.273 ~ −2.366	.022	−14.121	−23.847 ~ −4.394	.015
Whether LIKs were present in all trocha sites	1.476	−2.538 ~ 5.490	.485	2.086	−6.166 ~ 10.339	.629	3.562	−7.981 ~ 15.106	.557
Onset of LIKs	−5.426	−11.391 ~ 0.540	.100	−11.558	−23.822 ~ 0.705	.090	−16.984	−34.138 ~ 0.170	.076
Course of LIKs	−0.387	−0.801 ~ 0.027	.092	−0.585	−1.436 ~ 0.266	.203	−0.972	−2.163 ~ 0.219	.136

Abbreviation: LIK, Laparoscopically induced keloids.

with its multiple advantages such as minimally invasive and quick recovery. In laparoscopic surgery, intra-abdominal surgical procedures are performed with instruments through the trochas placed in the minor holes on the abdominal wall, thereby avoiding extensive damage to the abdominal skin and maintaining an aesthetic result. To the general public, the apparent scarring or keloid scarring caused by laparoscopy may be more than expected.

This article is the first to report a case series of LIKs. This type of keloid represents approximately 1.6% of our keloid database. There were two types of LIKs we noticed. When the specimen was taken out during the operation, an extended incision may sometimes be conducted on the trocha site, mainly the one located below the xiphoid process in laparoscopic cholecystectomy, leaving apparent damage to the abdominal wall skin. Such LIKs were generally long and "spreading." The other type of LIKs was formed on the trocha sites without extended, generally round, bulging, and primarily located in the umbilicus. These two types of keloid formation may be explained by their morphology. The keloids under the xiphoid process presented a "spreading" shape, which should be related to the tension of the upper abdomen.[1,14,15] A round bulging keloid on the umbilicus was similar in shape to a keloid on the earlobe. The keloids on the earlobe are mostly inflammatory sequelae caused by ear piercing.[11] The umbilicus is often prone to infections caused by bacteria, skin metabolites, and other substances (omphalitis).[16,17]

In the study, patients without non-LIKs had significantly higher severity than those with non-LIKs. Further statistical analysis showed that the presence of non-LIKs could significantly reduce the severity of the LIKs. We speculated that there might be three reasons for this negative adjustment to the severity. Patients with non-LIKs may have increased experience in treating keloids, resulting in an early consultation or better home care. Second, patients with non-LIKs have experienced the symptoms of keloids, thereby having an improved tolerance to the symptoms of laparoscopic keloids. Furthermore, patients with non-LIKs would recognise that they have a keloid constitution and have certain psychological expectations for the appearance of keloids caused by minimally invasive surgery. Patients without non-LIKs lacked such psychological expectations and were prone to be concerned about the symptoms, resulting in dissatisfaction and anxiety.

This study was a retrospective case series with certain limitations, such as failing to reveal the disease's risk factors. Future cohort studies and cross-sectional studies will contribute to more findings.

5 | CONCLUSION

Laparoscopic procedures could lead to the formation of keloids. Two types of LIKs were noticed: extended incisions induced long "spreading" type and trocha induced round bulging type. The presence of non-LIKs could significantly reduce the severity of LIKs.

DATA AVAILABILITY STATEMENT

Data available on request from the authors.

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