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REVIEW ARTICLE

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Chronic abdominal pain: the role of adhesions and benefit of laparoscopic adhesiolysis

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Abstract Abdominal adhesions can cause bowel obstruction, infertility, and chronic abdominal pain. In this review adhesion-related chronic abdominal pain, diagnostic laparoscopy and laparoscopic adhesiolysis as a treatment for chronic abdominal pain are discussed. There is no difference in benefit with the use of diagnostic laparoscopy versus laparoscopic adhesiolysis. Considering the risk of complications associated with laparoscopic adhesiolysis, it should no longer be recommended as therapy for adhesion-related chronic abdominal pain.

Keywords Adhesions · Chronic abdominal pain · Diagnostic laparoscopy · Laparoscopic adhesiolysis

Introduction

Abdominal adhesions, whether caused by (surgical) peritoneal trauma, infection, radiation or congenital origin, are considered to be associated with a range of complaints and complications, including infertility, small bowel obstruction, difficult reoperation, and chronic abdominal pain (CAP) [1]. Approximately 1% of all surgical admissions and 3% of laparotomies are the result of intestinal obstruction from adhesions [2]. The treatment of patients with symptoms caused by adhesions will also generate extra costs; in the US alone the costs of surgery for abdominal adhesions exceed $1 billion annually [3, 4]. The amount of adhesions found at operation is positively correlated with the number of previous operations a patient has undergone [5].

Concerning CAP, many other organic and functional diseases can be the cause such as irritable bowel disease, functional dyspepsia, and various esophageal, biliary, and urologic disorders [6]. In this review the focus is on CAP, caused by abdominal adhesions and the place of laparoscopic adhesiolysis in this subgroup.

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Chronic abdominal pain after previous abdominal surgery

Chronic abdominal pain remains elusive to all known methods of diagnosis and treatment. It is a common disorder both in general and specialized surgical practice and patients may have undergone numerous diagnostic work-ups including surgery [6]. CAP can, just like infertility and small bowel obstruction, be a sequela of adhesions and it may present as continuous or colicky pain. Continuous pain is considered to occur when adhesions retract the viscera without obstructing them, whereas colicky or intermittent pain is suggestive of obstruction.

In 2001, Sulaiman et al. [7] found sensory, substance P-containing nerve fibers in human peritoneal adhesions, suggesting the possibility of conducting pain after appropriate stimulation. Although pain physiologic studies were not conducted, it is very possible that the thin, nonmyelinated fibers that were observed conduct pain stimuli. However, not all patients in this study experienced chronic pelvic pain; therefore, although all adhesions may be able to directly induce pain sensations, there are likely to be other factors to consider in addition to the innervation, such as peritoneal pathology, organ mobility, and psychosomatic manifestations. Commonly, investigating abdominal pain includes ruling out gastritis, cholecystolithiasis, irritable bowel disease, functional dyspepsia, diverticulosis, pancreatitis, renal concrements, arteriosclerosis of visceral arteries, parasitic disease, or lactase deficiency [8]. In patients with colicky pain, as mentioned previously, obstruction is more likely. Auscultation of the abdomen or plain radiographs of the abdomen at the time of colicky pain can render intestinal obstruction more likely. When bowel obstruction is suspected, enteroclysis combined with either colonoscopy or barium enema may detect serious ailments such as inflammatory bowel disease, tumors or volvulus. Thorough investigations to exclude pathology

other than adhesions are of paramount importance to ensure the proper selection of those patients with chronic abdominal pain who may benefit from adhesiolysis.

Nowadays, laparoscopy is most commonly used to assess and take down adhesions, as will be discussed later on. Once adhesions have been found at surgery, it is difficult to determine which adhesions are liable to cause pain.

To address this problem, Leidig and Krakamp performed laparoscopy using local anesthesia, enabling the patient to indicate which adhesions were causing the pain upon stretching [9]. After adhesiolysis, 70% of the patients reported an improvement and 29% were free of pain.

In 2004, Demco set out to determine the nature and location of adhesions and their relationship to abdominal pain in patients undergoing awake microlaparoscopy [10]. Thirty women, aged 26–49 years, suffering from chronic pelvic pain, were kept awake during their laparoscopy to determine the site and degree of pain when the adhesions were manipulated. Demco stated that filmy adhesions between a movable structure, such as an ovary, and the peritoneum produced the highest pain scores, whereas fixed or dense adhesions, no matter where they were located, showed the lowest pain scores.

Mueller et al. [11] take it one step further as they state that only adhesions that limit movement of the organs are likely to cause pain.

To investigate whether the extent of adhesions is correlated with the preoperative symptoms, several studies were conducted [12–14].

Freys et al. [12] in 1994 found small adhesions to cause recurrent abdominal pain without other symptoms, whereas large adhesions produce recurrent abdominal pain in combination with symptoms indicative of intermittent bowel obstruction. Their results indicate a certain ‘‘ideal constellation’’ for an enduring successful adhesiolysis per laparoscopy: the subjective complaint of recurrent abdominal pain with a localized and reproducible punctum maximum in combination with a circumscribed area of adhesions at that site.

In 1986, Rapkin [13] retrospectively reviewed 100 consecutive laparoscopies for chronic pelvic pain and 88 for infertility. Twenty-six of the 100 (26%) chronic pelvic pain patients and 34 of the 88 (39%) infertility patients exhibited pelvic adhesions as the only abnormal finding. Patients in each group with findings of pelvic adhesions were compared with regard to symptomatology, density of adhesions, and locations of adhesions. Only 4 of the 34 infertility patients in whom pelvic adhesions were found complained of pain. Comparison of the chronic pelvic pain patients and the asymptomatic infertility patients did not reveal a significant difference in the density or the location of adhesions.

In 1991, Stout et al. [14] used standardized measures of behavioral and psychosocial factors associated with other chronic pain conditions to interview 102 women scheduled for laparoscopic surgery. Surgeons who were blinded to the patient’s self-reported pain data completed the American Fertility Society (AFS) classification for endometriosis and adhesions on the basis of observed physical disease. Although AFS classification scores were significantly related to self-assignment into “pain” or “no-pain” groups, the extent of physical disease evaluated by this procedure was not significantly correlated with ratings of pain levels or a number of indexes of impairment.

The site of CAP correlated well with the location of adhesions according to Stout et al. [14], but Rapkin [13] failed to find such a correlation. The pathophysiology of CAP is still poorly understood [15] and it is very possible that psychosocial factors play a role in chronic abdominal pain [16].

Recently, the development of tools for brain investigation, such as functional magnetic resonance imaging, has provided new insights into the pathophysiology of chronic pain. These data have shown that plastic changes in the central and peripheral nervous system may play an important role in the maintenance of chronic pain. Therefore, approaches aimed at the modulation of the nervous system, rather than those interfering with the inflammatory pathways, may be more effective for chronic pain treatment [17]. As mentioned before [7] adhesions were shown to contain nerve fibers that are likely to conduct pain stimuli, so the assumption that chronic abdominal pain due to adhesions has a psychosomatic origin may be unlikely.

Many studies indicate that the results of adhesiolysis deteriorate over time [18–24]. Because the CAP syndrome also has many psychosocial aspects [25], one could assume that the benefit of laparoscopic intervention may diminish during the follow-up period. The fact that de novo formation of adhesions is to be expected after adhesiolysis [26], and that the severity of adhesions increases over time [27] might be an explanation of the recurrence of pain. The temporary relief of pain might also be explained by the placebo effect [28]. The highest reported recurrence rate was 26% [20], and the longest pain-free interval was 2 years [18]. According to Mecke et al. [29], a longer duration of preoperative symptoms predisposes to a lower success rate. Unfortunately, no validated pain scores were used in most series, and the duration of follow-up was not given in precise terms by most authors.

Laparoscopy allows surgeons to see and treat many abdominal changes that could not be diagnosed otherwise [30, 31]. In 35–50% of the patients with CAP, adhesions may be the only explanation [32, 33], but consensus about the causal association of adhesions with pain is still not achieved. As stated before, intra-abdominal adhesions may be asymptomatic, but in some cases also a significant cause of morbidity, such as infertility, bowel obstruction, and pain [34].

Diagnostic laparoscopy

Consensus exists with regard to the indications for diagnostic laparoscopy for chronic abdominal pain if other pathology has been excluded.

In a prospective study of 70 patients suffering chronic abdominal pain, Onders and Mittendorf [30] described the findings during diagnostic laparoscopy. Adhesion (57%),

hernia (18%), and abnormal appendices (16%) were the most common diagnoses. In 10 patients no pathology at all was found. These findings correspond with those reported by Salky and Edye as well as Klingensmith (Table 1) [32, 33].

Concerning adhesions, Swank et al. [35] found a much higher incidence (96%) at diagnostic laparoscopy; however, this was in a patient population most of whom had undergone previous surgery (commonly appendectomy, ovary surgery, hysterectomy, bowel and stomach resection, splenectomy, and cholecystectomy). This difference in previous surgery may be held responsible for the high incidence of adhesion in the aforementioned study. It becomes clear that adhesion incidences found at diagnostic laparoscopy may vary considerably.

Therapeutic value of diagnostic laparoscopy

It is suggested that even if no pathology, besides adhesions, is found, diagnostic laparoscopy alone may improve pain in 32% of patients [33].

Swank et al. supplied definite proof from a double blinded, randomized controlled trial comparing laparoscopic adhesiolysis and diagnostic laparoscopy. Of the control group of 48 patients who had undergone only diagnostic laparoscopy, 42% reported improvement of pain at 12 months' follow-up (Table 2) [35].

Hypothetically, the beneficial effect of diagnostic laparoscopy could be a result of peritoneal distension, caused by the pneumoperitoneum; on the other hand a placebo effect cannot be ruled out [35, 36].

Laparoscopic adhesiolysis

Adhesiolysis is frequently an integral part of open and minimally invasive abdominal surgery and adhesions can complicate subsequent laparoscopic interventions.

Ballesta Lopez et al. [37] studied 240 patients who underwent laparoscopic procedures after at least one previous laparotomy resulting in 1.5% conversions to open surgery and a 4% complication rate. Surgery in a previously opened abdomen is described as being difficult.

Fathy et al. confirmed that adhesions were the most common cause of conversions (57 patients; 2.9%) in 2,000 patients undergoing laparoscopic cholecystectomy [38].

Karayiannakis et al. pointed out that previous abdominal surgery is not a contraindication for laparoscopic cholecystectomy per se. However, 78% of patients required adhesiolysis and conversion to open surgery was required in 19%. Alternatively, laparoscopic cholecystectomy was converted to an open approach in a previously unoperated abdomen in only 5% of patients [39].

Completeness of adhesiolysis

Swank et al. prospectively analyzed predictive factors on the results of laparoscopic adhesiolysis for chronic abdominal pain. In this series of 200 consecutive patients with only adhesions as a likely cause of their pain, complete adhesiolysis was intended, which was possible in 82% of patients. Three months after laparoscopic adhesiolysis 74% of patients were pain-free or suffered from less pain, 22% of patients experienced no change in abdominal pain, and 4% of patients reported an increase in abdominal pain. Pain relief was found to be unrelated to the completeness of laparoscopic adhesiolysis. Older age and female gender appeared to be individual factors associated with disappointing pain relief [40]. As mentioned previously, results by Swank et al. proved that 42% of patients with adhesions experienced pain relief after sham laparoscopic adhesiolysis (diagnostic laparoscopy) in which identified adhesions were not lyzed [35]. On the other hand, Onders and Mittendorf recommend complete adhesiolysis if adhesions are the likely etiology of chronic pain. However, their paper did not mention the classification or severity of adhesions, and their technique and results suggest less severe ("friendly") adhesions [30].

Table 1 Findings during diagnostic laparoscopy

	Klingensmith et al. (1996) [33]	Salky and Edye (1998) [32]	Onders and Mittendorf (2003) [30]	Swank et al. (2003) [50]	Paajanen et al. (2005) [6]
Number of patients	34	265	70	340	72
Pathology (%)[a]					
Adhesions	58	26	56	96	85
None	30	24	14	2	8
Hernia	9	2	19	1	1.4
Abnormal appendix	3	26	16	1	1.4
Endometriosis	6	3	4	–	–
Abnormal gallbladder	3	2	3	2	–
Miscellaneous	6	20	–	2	5.5%[b]

[a]Some patients had more than one finding
[b]Unspecified gynecological disorders

Adhesiolysis as treatment for CAP

The success rate of laparoscopic adhesiolysis for bowel obstruction, chronic pain, and infertility varied from 38 to 87% of patients in 24 publications (Table 2).

The number of patients studied varied between 11 and 200 and included a range of follow-ups (at least 3 months, at most 5 years). Abdominal pain recurrence rates of up to 26% are described.

Swank et al. performed a prospective study in 224 patients with chronic abdominal pain looking specifically for factors influencing the result of laparoscopic adhesiolysis such as completeness of adhesiolysis, gender, and age. After 3 months, 74% of patients were pain-free or had less pain. As mentioned earlier, it emerged that younger patients were more likely to become pain-free, whereas after previous gynecological operations women were significantly less pain-free than men after all other types of intervention. Results of adhesiolysis were unrelated to the duration of pain, the number and type of previous operations, the technique, and (in)completeness of adhesiolysis [40].

In 11 patients (5.5%) bowel perforations occurred during laparoscopic adhesiolysis, leading to laparotomy in all patients. This contributed significantly to the disappointing results in the aforementioned study (unaffected pain or increased pain).

Onders and Mittendorf showed a long-term success rate in 71% of 45 patients with chronic abdominal pain after complete adhesiolysis. Initially, these patients were 100% satisfied. After 6 months, however, 29% of patients after adhesiolysis suffered from recurrent abdominal pain. A subsequent follow-up (mean period 129 weeks) showed no further recurrences. The authors hypothesized that adhesion recurrence and de novo adhesion formation cause recurrent abdominal pain. A placebo effect and the subsequent wearing off were also postulated as causes of recurrent pain [30].

In the double blinded, randomized controlled trial mentioned earlier, 116 patients suffering from CAP, which was likely to have been caused by prior abdominal surgery and present for at least half a year, were enrolled. All patients underwent diagnostic laparoscopy, and in the case of evident adhesions only, were randomized for treatment (adhesiolysis) or continuation of diagnostic laparoscopy. For a period of 1 year, patients remained unaware of the group for which they had been randomized.

After 6 months, 52 patients treated by adhesiolysis reported an improvement in the pain (57% of patients), had a reduced visual analogue pain score (VAS; 57 versus 38), a reduced MOS SF-36 score, required less analgesics, and felt that their quality of life (QOL) had signifcantly improved. Results at 1-year follow-up were no different from results after 6 months. None of the results in the

Table 2 Outcome of adhesiolysis in patients with chronic abdominal pain for no other cause than adhesions

Reference	*N*	Cured/improved (%)	Unchanged/worse (%)	No response (%)	Follow-up (months)	Method
[51]	43	28 (65.1)	14 (32.5)	1 (2.4)	Minimum, 6	Laparoscopy
[52]	27	16 (59)	11 (41)	–	Unknown	Laparotomy
[29]	52	23 (44)	16 (31)	13 (25)	6	Laparoscopy
[22]	65	53 (82)	10 (15)	2 (3)	1–5 years	Laparoscopy
[21]	30	19 (63)	11 (37)	–	6–12 (mean, 8.2)	Combined[a]
[18]	153	58 (38)	42 (27)	54 (35)	12–96	Laparoscopy
[53]	24	11 (46)	13 (54)	–	9–12	Laparotomy
[23]	23	15 (65)	4 (17)	4 (17)	5–36 (mean, 18.3)	Laparoscopy
[54]	11	9 (82)	–	2 (18)	Mean 10.7±3.8	Laparoscopy
[12]	58	46 (80)	12 (20)	–	≤30	Laparoscopy
[43]	35	28 (80)	5 (14)	2 (6)	22±4	Laparoscopy
[24]	105	63 (60)	35 (33)	7 (7)	6	Laparoscopy
[11]	45	30 (67)	6 (13)	9 (20)	6–36 (median, 10)	Laparoscopy
[20]	123	82 (67)	41 (33)	–	2–53 (mean, 14)	Combined[a]
[55]	16	14 (87)	2 (13)	–	4–18	Laparoscopy
[56]	19	16 (84)	3 (16)	–	Mean, 18	Laparoscopy
[57]	48	22 (46)	24 (50)	2 (4)	≤60	Laparoscopy
[33]	19	14 (75)	5 (25)	–	3	Laparoscopy
[19]	24	17 (71)	5 (21)	2 (8)	4–43	Laparoscopy
[58]	48	32 (67)	16 (33)	–	2–5 years	Laparoscopy
[59]	45	34 (75)	7 (16)	4 (9)	12–41 (mean, 18.3)	Laparoscopy
[60]	44	37 (84)	7 (16)	–	4–18 (mean, 12)	Laparoscopy
[40]	200	148 (74)	52 (26)	–	3	Laparoscopy
[35]	100	22 (43)	30 (57)	–	12	Laparoscopy
[6]	72	57 (79)	15 (21)		44	Laparoscopy

[a]Combined = both laparoscopic and open adhesiolysis

treatment group were significantly superior to the patient having undergone diagnostic laparoscopy except for the number of complications as illustrated in Table 3. Complications after laparoscopic adhesiolysis in this study were comparable to those published elsewhere (Table 3) [35].

A recent, prospective study by Pajaanen in 72 patients after diagnostic laparoscopy and laparoscopic adhesiolysis reported favorable results (less pain and free of pain) in 79% (n=57 patients) after a mean follow-up of 44 months. In 6 patients no adhesions were found. It is noteworthy that the diagnostic laparoscopies revealed 1 umbilical hernia, 1 chronically inflamed veriform appendix, and 4 patients suffering from gynecological disease not diagnosed earlier (Table 1). The overall complication rate in the aforementioned study was reported to be 13.8% [6].

Complications of laparoscopic adhesiolysis

During laparoscopic adhesiolysis several complications can occur. Generally, wound hematoma, hernia, and infection are considered to be minor complications, whereas bleeding in the abdominal cavity and bowel perforation are classified as major complications [41]. The incidence of intestinal perforations that occur during laparoscopic procedures for symptomatic adhesions is reported to be between 5% and more than 25% of patients [42–46].

Bowel injuries not recognized at the time of surgery can result from needle introduction (a 0.05%–0.2% risk according to Bonjer et al. [47]), from trocar puncture or from adhesiolysis. The symptoms of peritonitis after a direct perforation are usually clear within 1 or 2 days. Thermal damage to the bowel may be another cause of bowel perforation, in which cases the clinical signs of perforation are usually seen after 4 days [45]. Previous operations (single as well as multiple) are an important factor causing complications during laparoscopic adhesiolysis, and in difficult cases with a progressive risk of complications it is better to accept incomplete adhesiolysis and wait for the possible relief of pain, rather than continue adhesiolysis and risking a perforation.

In the end, the goal is an asymptomatic patient rather than an abdominal cavity without adhesions [41].

Regrowth

In 24 patients a second-look procedure was performed as part of a follow-up study of 368 patients after laparoscopic adhesiolysis for the treatment of CAP [48]. The indication for second-look laparoscopy was recurrent pain after a mean period of 16 months.

New adhesions had formed among the organs and the differences in severity, incidence, and extent of the adhesions were not significant. A significant reduction in adhesions, however, remained between the organs and the abdominal wall.

The incidence, extent, and severity of abdominal adhesions was found to be permanently reduced after laparoscopic adhesiolysis, despite de novo adhesions in 5 patients (20%). Interestingly, 3 patients were totally free of abdominal adhesions at second-look laparoscopy [48]. It is generally postulated that adhesion formation is progressive the more laparotomies are performed [5, 49]; unfortunately no data are available on adhesion reformation after adhesiolysis by laparotomy.

Conclusion

Chronic abdominal pain can be caused by postoperative abdominal adhesions, whether by the nerve fibers in the adhesions themselves, by traction to the peritoneum or organs, or a combination of both, whereas changes in the central nervous system should be considered to play a role as well. All in all the phenomenon is highly complicated and there are almost always several causes to consider. Once causes other than adhesions have been ruled out, (laparoscopic) adhesiolysis is commonly attempted in order to free patients of chronic abdominal pain.

Our randomized study, performed by Swank et al., described for the first time that laparoscopic adhesiolysis was of equal benefit to patients as diagnostic laparoscopy. Serious complications (i.e., bowel perforations) as a result of laparoscopic adhesiolysis were found to occur in as many as 5% of patients [35]. From the results of the randomized study, abolition of laparoscopic adhesiolysis as the treatment of choice for chronic abdominal pain is recommended, since adhesiolysis and diagnostic laparos-

Table 3 Complications of laparoscopic adhesiolysis and diagnostic laparoscopy for chronic abdominal pain (*CAP*)

Reference	*N*	Pain relief, % of patients	Follow-up (months)	Complications (%)[b]	Indication
[61]	20	78	11	20 major	CAP; bowel obstruction
[40]	200	74	3	5.5	CAP
[35][a]	52	57	12	5	CAP
	48	42	12	–	CAP, diagnostic laparoscopy only
[33]	18	73	3	5 minor	CAP
	9	88	3	–	CAP, diagnostic laparoscopy only
[58]	48	64	6–12	10 major	CAP

[a]Randomized controlled trial
[b]Major complications: enterotomy, cystotomy

copy patients differed only with regard to complication rates, not with regard to benefit. All in all the best treatment of adhesions is their prevention.

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