

Selective laparoscopic adhesiolysis in the management of acute and chronic recurrent adhesive bowel obstruction

Akut ve kronik tekrarlayan, ameliyat sonrası yapışıklıklara bağlı bağırsak tıkanıklıklarının tedavisinde selektif laparoskopik adezyolizis

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BACKGROUND

Laparoscopic adhesiolysis became popular in the last decade for the management of postoperative adhesive small bowel obstruction. This paper investigates the feasibility, effectiveness and safety of laparoscopy in this field; the details of a selective adhesiolysis were discussed as well.

METHODS

The patients who underwent laparoscopic management of acute or chronic recurrent adhesive bowel obstruction were included into the study. The patients were managed according to a specific algorithm. If the conservative management has failed, selective laparoscopic adhesiolysis to the transition zone of distended/collapsed bowel was performed. Patients, who were suffering from chronic recurrent obstruction attacks and those who tolerated oral intake, underwent preoperative enteroclysis studies and selective adhesiolysis was performed according to imaging findings. Computerized tomography was performed in all cases to exclude other diagnoses.

RESULTS

Thirty-one patients (22 female, 9 male) underwent laparoscopic adhesiolysis from January 1998 to June 2007. The mean age was 48 (range: 20-80). Enteroclysis - guided laparoscopic adhesiolysis was performed in nineteen patients. Twelve patients underwent laparoscopic adhesiolysis for acute obstruction. Enteroclysis was able to demonstrate the pathological adhesion or band in all of the patients who underwent this imaging technique. Conversion and complication rates were 9.6%. The entire patients tolerated well oral intake postoperatively except one who had underwent enteroclysis-guided adhesiolysis; the patient presented with transient subileus on postoperative day 34 and responded well to conservative management. Mean hospital stay was 4.1 days (range: 2-7). The patients are free of symptoms on their follow-up.

CONCLUSION

Laparoscopy is feasible, safe and effective in postoperative adhesive disease. Laparoscopic adhesiolysis should be performed as selective as possible in acute and chronic cases. Enteroclysis is a helpful imaging modality for performing selective laparoscopic adhesiolysis in chronic obstruction.

Key Words: Adhesiolysis; adhesion; enteroclysis; laparoscopy.

AMAÇ

Laparoskopik adezyolizis adezyonlara bağlı ameliyat sonrası ince bağırsak tıkanıklıklarının tedavisinde son dekada popülerite kazanmıştır. Bu çalışmada, laparoskopinin bu alanda uygulanabilirliği, etkinliği ve güvenliğini araştırıldı ve selektif adezyolizisin ayrıntıları tartışıldı.

GEREÇ VE YÖNTEM

Bu çalışmaya yapışıklıklara bağlı, akut veya kronik tekrarlayan ince bağırsak tıkanıklığı nedeniyle laparoskopik tedavi görmüş hastalar dahil edildi. Hastalar belirli bir algoritmaya göre tedavi gördü. Konservatif tedavinin yetersiz kaldığı hastalar ameliyata alınarak sönük/şişkin bağırsak geçişinin olduğu bölgeye selektif laparoskopik adezyolizis uygulandı. Kronik tekrarlayan ataklar geçiren ve konservatif tedaviye yanıt vermiş hastalarda ameliyat öncesi enteroklizis uygulandı ve adezyolizis bu bulgular kılavuzluğunda yapıldı. Diğer tanıları dışlamak amacıyla tüm olgularda bilgisayarlı tomografi incelenmesi yapıldı.

BULGULAR

Ocak 1998 - Haziran 2007 tarihleri arasında 31 hastaya (22 kadın, 9 erkek) laparoskopik adezyolizis yapıldı. Ortalama yaş 48 (aralık 20-80) idi. Enteroklizis kılavuzluğunda laparoskopik adezyolizis 19 hastada uygulandı. On iki hastaya akut tıkanıklık nedeniyle laparoskopik adezyolizis uygulandı. Enteroklizis, bu görüntüleme yönteminin uygulandığı hastaların tümünde patolojik yapışıklık veya bandı göstermeyi başardı. Komplikasyon ve açığa geçiş oranı %9,6 olarak gerçekleşti. Hastaların tümünde ameliyat sonrası dönemde oral alım tolere edildi. Enteroklizis kılavuzluğunda laparoskopik adezyolizis uygulanmış bir hastada ameliyat sonrası 34. günde konservatif tedaviye yanıt veren geçici subileus atağı oldu. Ortalama hastanede yatış süresi 4,1 gün (aralık: 2-7) olarak gerçekleşti. Hastalar takiplerinde semptomsuz seyretmektedir.

SONUÇ

Ameliyat sonrası yapışıklıklara bağlı bağırsak tıkanıklarında laparoskopik uygulanabilir, güvenli ve etkin bir yöntemdir. Laparoskopik akut veya kronik olgularda olabildiğince selektif uygulanmalıdır. Enteroklizis, kronik tıkanıklıklarda selektif laparoskopik uygulanmasına olanak veren yararlı bir görüntüleme yöntemidir.

Anahtar Sözcükler: Adezyon; adezyolizis; enteroklizis; laparoskopik.

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Postoperative adhesive disease (PAD) is not an uncommon disorder, and the incidence ranges between 12% and 17%^[1] following abdominal surgery. This is a disturbing clinical illness which usually includes small bowel obstruction (SBO) and colicky abdominal pain. As the abdominal operation rate increases, PAD is becoming more frequent. PAD is still the leading cause of SBO in developed countries.^[2]

Although many patients with SBO related to PAD benefit from conservative management, there is still a group where surgery is being required.^[3,4] Until recently, laparotomy was the only method of surgical treatment but it is associated with new adhesion formation, ventral hernia, increased postoperative pain and postoperative ileus.^[4,5]

In the early era of laparoscopic surgery, prior abdominal surgery was considered as a contraindication, however with growing experience in this minimally invasive technique, laparoscopic treatment of PAD is being achieved with excellent results.^[6-19] Laparoscopy was shown to be related with fewer intraperitoneal adhesions.^[20,21] Furthermore, the technique includes reduced incision of the parietal peritoneum, less insertion of foreign bodies into peritoneal cavity, fewer tissue traumas and the surgery is performed in a more humid and closed environment without manipulating the intraabdominal structures distant from the operation field. These features make laparoscopy an ideal approach for the surgical management of PAD.

However, the extent of laparoscopic adhesiolysis was also questioned recently. Some authors emphasize that adhesiolysis must be limited to pathological adhesions given that many adhesions have no relationship with clinical symptoms.^[6,15,18,19] The dissection of an innocent adhesion can be resulted in a new kinking or adhesion which might lead to SBO. Thus, a new perspective emerged with this question: "How can we perform laparoscopic adhesiolysis less traumatic and more specific?".

Undoubtedly, preoperative diagnosis of the pathological adhesion is the most critical step in performing a selective adhesiolysis, since surgical exploration seldom offers satisfactory clues, especially in chronic recurrent cases. We have previously reported our experience in using enteroclysis as guide for performing a selective adhesiolysis in chro-

nic recurrent PAD.^[6] Enteroclysis-guided laparoscopic adhesiolysis allows surgeons to perform lyses directly to the pathological site. Moreover, differential diagnosis of PAD with other disorders such as radiation enteritis, Crohn's disease, tumor recurrence is vital and enteroclysis is one of the best methods to do it. However, this preoperative investigation is not practicable in acute obstruction and usually, computerized tomography (CT) is performed for excluding other diagnoses. Hence, discovering the transition zone which includes the distended and collapsed bowel segments is the landmark during laparoscopic exploration of acute cases. In summary selective laparoscopic adhesiolysis necessitates a detailed preoperative investigation and meticulous surgical maneuvers.

This present study includes the patients undergoing selective laparoscopic adhesiolysis for acute or recurrent chronic obstruction. The surgical strategy was to fulfill a detailed preoperative imaging and perform adhesiolysis as specific as possible.

MATERIALS AND METHODS

The patients who underwent laparoscopic management of acute or chronic recurrent adhesive bowel obstruction in the Emergency Unit of Cerrahpasa Medical Faculty, Istanbul University, were included into the study. An informed consent for laparoscopic surgery and possible conversion to laparotomy was obtained from all patients. Bowel obstruction was diagnosed by imaging modalities, patient's history and clinical examination. The patients who had unrelated etiologies, such as tumors, Crohn's disease, radiation enteritis etc., were excluded from the study group.

Algorithm

The patients were managed according to a specific algorithm. At first admission, conservative management, including nasogastric suction and fluid resuscitation were performed initially, in all patients. An abdominal computerized tomography (CT) was performed at this step, in order to confirm adhesive disease and rule out an intra-abdominal tumor etc. If the conservative management has failed, patients underwent "laparoscopic adhesiolysis for acute obstruction". However, when the bowel obstruction has relieved by conservative management, the patient was discharged and taken to periodical follow-up. The patients who had suffered from a

previous bout of bowel obstruction in patient's history or those who had a recurrent attack on follow-up were hospitalized. Once more, they were managed by conservative management and if this latter succeeds, enteroclysis examination was considered. The patients were checked during 24-48 hours with liquid and semi-solid diet, before enteroclysis, in order to confirm that they do not present a new attack of intestinal obstruction. So, enteroclysis was performed in patients who had at least two episodes of bowel obstruction and have tolerated oral intake.

Operative technique

The patient was laid in supine position. Subsequent to endo-tracheal intubation, a Foley catheter and a large bore-nasogastric tube were applied. The position of the monitor was also decided upon findings of the results of enteroclysis and computed tomography. If the adhesions were supposed to be at right site, surgeon operated from patient's left and the monitor was placed at right site; patient's left arm was kept in adduction as well. The inverse positions were arranged for left sided adhesions. Pneumoperitoneum and the first port's insertion were carried out by open technique through an area which was expected to be adhesion-free according to imaging studies and prior incision scar or scars. For midline or bilateral adhesions, the operating surgeon stood at patient's left. Then additional ports, preferably 10 mm in diameter, were inserted according to the locations of the adhesions. A 30° angled side viewing laparoscope and a total of 3 to 5 ports were used during operations. Laparoscopic adhesiolysis technique has depended on whether the case was acute or chronic. In patients with chronic recurrent adhesive disease, the adhesions which are not impeding bowel transit according to the enteroclysis, were not divided; however, to get a better visual field, the ones that conceal operative field at the ventral abdominal wall were cleaned. Then, the adhesions or bands which had been demonstrated in enteroclysis were dissected. For acute obstructions, adhesiolysis was performed to the adhesions or bands at transition zone, which included the distended and collapsed bowels along with bands and adhesions. This zone was considered as the landmark in acute obstruction. In order to find this area we explored the small bowel from ileocecal valve through Tretiz's ligament by retrograde manner.

Non traumatic endo-babcocks and graspers were used while running the bowels. Adhesiolysis was performed by mostly sharp, occasionally blunt dissections; electrocautery was employed only for hemostasis regarding its negative effects on peritoneal ischemia, a strong promoter of de novo adhesion formation. Adhesiolysis was considered to be successful when all of the pathological adhesions which were shown by enteroclysis had been dissected in chronic cases; for acute obstruction the identification and dissection of the adhesions at transition zone were the criteria. After the completion of adhesiolysis, abdominal cavity was irrigated by saline solution and omentum was placed between intestine and ventral wall of abdomen as much as possible. Hyaluronic acid and carboxymethylcellulose anti-adhesive membrane (Seprafilm®, Genzyme Co, MA, USA) was placed in selected cases.

All the patients were allowed to liquid diet on postoperative day one and at the same day prokinetic drugs were used to stimulate peristalsis. In patients who underwent bowel repair, liquid diet was re-started on postoperative day four.

RESULTS

Thirty-one patients underwent laparoscopic adhesiolysis from January 1998 to June 2007. Twenty-two patients were female and nine were male. The mean age was 48 (range: 20-80).

Enteroclysis - guided adhesiolysis was performed in nineteen patients for recurrent disease. Further twelve patients underwent laparoscopic adhesiolysis for acute obstruction. Enteroclysis was able to demonstrate the pathological adhesion or band in all of the patients undergoing this imaging technique. Moreover, the results of computed tomography studies were comparable to laparoscopic findings as well.

The procedure was converted to laparotomy in three patients (9.6%); the indications were excessive adhesions and bowel injury in one and two patients respectively. Operative complications included three iatrogenic bowel injuries (9.6%). Two of them were repaired by mini-laparotomy whereas laparoscopic intracorporeal repair by simple interrupted sutures was performed in one patient.

All of the patients tolerated well oral intake postoperatively and bowel obstruction signs ceased. Mean hospital stay was 4.1 days (range: 2-7). One patient who had underwent enteroclysis-guided ad-

hesiolysis presented with transient subileus on postoperative day 34 which responded well to conservative management. The remaining patients are free of symptoms on their follow-up.

DISCUSSION

As indicated by the results of this study, selective laparoscopic adhesiolysis is feasible, efficient and safe in acute and chronic PAD. A dynamic preoperative diagnostic work allowed performing a specific laparoscopic adhesiolysis with low percentage of conversion to laparotomy.

Laparoscopic surgery was introduced in the late 80's with laparoscopic cholecystectomy. At initial period, the technique was considered unsafe in obese patients or those who had underwent prior abdominal surgery; however this belief has completely abandoned later on, so that those patients are now excellent candidates for laparoscopy in order to perform obesity surgery or adhesiolysis. Laparoscopic adhesiolysis is now being performed in many centers with results comparable or superior to open surgery.^[6-19,22-25] Since the method is relatively new, there is still not a uniform clear-cut algorithm, preoperative investigation checklist and patient selection strategy. Furthermore technical details are dissimilar and the extent of the adhesiolysis is still a matter of debate.

The role of laparoscopy has some other vital aspects concerning the treatment of PAD. Ziprin et al. simulated the environment of laparoscopy by carbon dioxide or helium and showed that plasminogen activator inhibitor -1 activity has decreased in such a milieu; this fact was associated with an increase in fibrinolytic activity, thus reduction of adhesions.^[26] Moreover, Tittel et al. reported that the risk for adhesion re-formation is less after laparoscopic adhesiolysis in their experimental study, just like Garrard et al. who demonstrated that adhesions are less after laparoscopic surgery.^[20,21] The adhesion re-formation after adhesiolysis is extremely important in patients who are already suffering from this disorder. These evidences clearly illustrate beneficial aspects of laparoscopy on adhesion formation and this technique might be the treatment of choice in PAD.

Ibrahim et al. reported one of the initial laparoscopic adhesiolysis series in the literature, including 25 patients with acute bowel obstruction related to

PAD.^[12] The successful rate of adhesiolysis was 72%. Nevertheless, the authors included all kind of small bowel obstructions together, which was deteriorating the focus of the conclusions. This confusing method was preferred in a significant number of other studies, certainly for enlarging study groups.^[7-11,13,16] Fortunately, recent articles investigate the role of laparoscopy, exclusively in PAD.^[6,14,15,17] The results are very promising. Mortality rate is very low (0 - 3%) and the technique was reported to be successful in 80-100% of the patients.^[3] According to selected series, the conversion and iatrogenic bowel injury rate are 6.7-43% respectively.^[3,4] The highest conversion rates were reported by Suter et al and Levard et al. as 43% and 41% respectively.^[11,26] In the former study, the correct rate of conversion was unfortunately not stated for the patients with PAD and this rate included all kind of SBO, like tumors or inflammatory strictures.^[26] Moreover, the latter article is a multi-centre study, including the results of 35 centers between 1988 and 1996. Although the data is large (n=308), the high conversion rate of this multi-centre study is poorly reflecting current status of laparoscopic adhesiolysis, regarding early study period and diversity of the centers where the laparoscopic procedures had been performed.^[11]

The preoperative imaging modalities mostly include plain abdominal X-ray, abdominal CT and enteroclysis. It is not feasible to perform enteroclysis in acute cases because the patients must tolerate oral intake. This dynamic small bowel investigation is very useful in chronic recurrent SBO, as it reveals the location, degree and nature of the obstruction; the differential diagnosis can be made preoperatively between PAD and other etiologies such as Crohn's disease, tumors, radiation enteritis etc. The enteroclysis can be performed also by magnetic resonance imaging for the pathologies of the small bowel.^[27] In addition, abdominal CT is also useful to demonstrate the etiology and site of the obstruction. We do warmly suggest and perform as an initial diagnostic modality, the abdominal CT examination in all of the patients with SBO since it may perform differential diagnosis in acute obstruction and highly informative in combination with enteroclysis in chronic recurrent PAD.

The extent of the adhesiolysis is a critical issue and there is still not a common agreement on the li-

mits of surgery. Some authors perform total adhesiolysis between Treitz's ligament and ileocecal valve.^[17,28] But, extensive adhesiolysis increases the risk of adhesion re-formation and some innocent adhesions can be transformed to pathological ones. So, a selective adhesiolysis is critical in acute and chronic recurrent SBO. But selective surgery requires the identification of the "responsible" adhesions. This is relatively easier in acute obstruction since the transition zone, including distended and collapsed bowel segments, is a reliable landmark. Many surgeons use this tip during laparoscopic investigation.^[7-9] However, such a landmark is not present in patients who suffer from chronic recurrent bouts of obstruction. We have previously reported our experience in enteroclysis - guided laparoscopic adhesiolysis in chronic recurrent PAD.^[6] This approach is based on the preoperative identification of pathological adhesions by enteroclysis and performance of selective limited laparoscopic adhesiolysis on this area. Although the number of the patients was limited to 15 the results are promising; the treatment was successful in all of the patients with a low conversion (6.7%) and complication (6.7%) rates. This study showed that enteroclysis enabled performing a selective adhesiolysis in chronic cases.

The first trocar insertion of laparoscopic adhesiolysis is another matter of debate. The technique of first trocar insertion is important since intra-abdominal adhesions are known to be present inside abdominal cavity. The bowel injury at this step was reported to be 3.7%.^[24] Some suggest left upper quadrant blind cannulation with a Veress needle, and they claim that adhesions are rare in this area.^[19,23,28,29] This hypothetical belief is not based on evidences and we have previously reported that adhesions may, not always but sometimes, be present in left upper quadrant even if the patient had underwent surgery in the pelvis.^[6] Therefore, we always perform open insertion of the first trocar in an area which is supposed to be adhesion free, according to previous scars and the results of CT and enteroclysis studies.

In summary, the results of this study revealed that laparoscopy is feasible, safe and efficient in the surgical management of PAD. Enteroclysis is very helpful in describing the strategy of laparoscopic adhesiolysis. While combining current status of laparoscopy in PAD and these present results, it is would not be too enthusiastic to mention that futu-

re projections for the treatment of acute and chronic PAD must include laparoscopic adhesiolysis as a treatment of choice. The advantage of laparoscopy is unquestionable in PAD, thus this method should have place in surgical training of residents. It is obvious that larger series are needed to have an ultimate conclusion.

REFERENCES

1. Beck DE, Opelka FG, Bailey HR, Rauh SM, Pashos CL. Incidence of small-bowel obstruction and adhesiolysis after open colorectal and general surgery. *Dis Colon Rectum* 1999;42:241-8.
2. Miller G, Boman J, Shrier I, Gordon PH. Etiology of small bowel obstruction. *Am J Surg* 2000;180:33-6.
3. Nagle A, Ujiki M, Denham W, Murayama K. Laparoscopic adhesiolysis for small bowel obstruction. *Am J Surg* 2004;187:464-70.
4. Szomstein S, Lo Menzo E, Simpfendorfer C, Zundel N, Rosenthal RJ. Laparoscopic lysis of adhesions. *World J Surg* 2006;30:535-40.
5. Duepre HJ, Senagore AJ, Delaney CP, Fazio VW. Does means of access affect the incidence of small bowel obstruction and ventral hernia after bowel resection? Laparoscopy versus laparotomy. *J Am Coll Surg* 2003;197:177-81.
6. Pekmezci S, Altinli E, Saribeyoglu K, Carkman S, Hamzaoglu I, Paksoy M, et al. Enteroclysis-guided laparoscopic adhesiolysis in recurrent adhesive small bowel obstructions. *Surg Laparosc Endosc Percutan Tech* 2002;12:165-70.
7. Kirshtein B, Roy-Shapira A, Lantsberg L, Avinoach E, Mizrahi S. Laparoscopic management of acute small bowel obstruction. *Surg Endosc* 2005;19:464-7.
8. Bailey IS, Rhodes M, O'Rourke N, Nathanson L, Fielding G. Laparoscopic management of acute small bowel obstruction. *Br J Surg* 1998;85:84-7.
9. Strickland P, Lourie DJ, Suddleson EA, Blitz JB, Stain SC. Is laparoscopy safe and effective for treatment of acute small-bowel obstruction? *Surg Endosc* 1999;13:695-8.
10. Franklin ME Jr, Gonzalez JJ Jr, Miter DB, Glass JL, Paulson D. Laparoscopic diagnosis and treatment of intestinal obstruction. *Surg Endosc* 2004;18:26-30.
11. Levard H, Boudet MJ, Msika S, Molkhou JM, Hay JM, Laborde Y, et al. Laparoscopic treatment of acute small bowel obstruction: a multicentre retrospective study. *ANZ J Surg* 2001;71:641-6.
12. Ibrahim IM, Wolodiger F, Sussman B, Kahn M, Silvestri F, Sabar A. Laparoscopic management of acute small-bowel obstruction. *Surg Endosc* 1996;10:1012-5.
13. Liauw JJ, Cheah WK. Laparoscopic management of acute small bowel obstruction. *Asian J Surg* 2005;28:185-8.
14. Wullstein C, Gross E. Laparoscopic compared with conventional treatment of acute adhesive small bowel

- obstruction. *Br J Surg* 2003;90:1147-51.
15. Sato Y, Ido K, Kumagai M, Isoda N, Hozumi M, Nagamine N, et al. Laparoscopic adhesiolysis for recurrent small bowel obstruction: long-term follow-up. *Gastrointest Endosc* 2001;54:476-9.
 16. Léon EL, Metzger A, Tsiotos GG, Schlinkert RT, Sarr MG. Laparoscopic management of small bowel obstruction: indications and outcome. *J Gastrointest Surg* 1998;2:132-40.
 17. Borzellino G, Tasselli S, Zerman G, Pedrazzani C, Manzoni G. Laparoscopic approach to postoperative adhesive obstruction. *Surg Endosc* 2004;18:686-90.
 18. Freys SM, Fuchs KH, Heimbucher J, Thiede A. Laparoscopic adhesiolysis. *Surg Endosc* 1994;8:1202-7.
 19. Mueller MD, Tschudi J, Herrmann U, Klaiber C. An evaluation of laparoscopic adhesiolysis in patients with chronic abdominal pain. *Surg Endosc* 1995;9:802-4.
 20. Tittel A, Treutner KH, Titkova S, Ottinger A, Schumpelick V. Comparison of adhesion reformation after laparoscopic and conventional adhesiolysis in an animal model. *Langenbecks Arch Surg* 2001;386:141-5.
 21. Garrard CL, Clements RH, Nanney L, Davidson JM, Richards WO. Adhesion formation is reduced after laparoscopic surgery. *Surg Endosc* 1999;13:10-3.
 22. Navez B, Arimont JM, Guiot P. Laparoscopic approach in acute small bowel obstruction. A review of 68 patients. *Hepatogastroenterology* 1998;45:2146-50.
 23. Al-Mulhim AA. Laparoscopic management of acute small bowel obstruction. Experience from a Saudi teaching hospital. *Surg Endosc* 2000;14:157-60.
 24. Chosidow D, Johanet H, Montariol T, Kielt R, Manceau C, Marmuse JP, et al. Laparoscopy for acute small-bowel obstruction secondary to adhesions. *J Laparoendosc Adv Surg Tech A* 2000;10:155-9.
 25. Suter M, Zermatten P, Halkic N, Martinet O, Bettschart V. Laparoscopic management of mechanical small bowel obstruction: are there predictors of success or failure? *Surg Endosc* 2000;14:478-83.
 26. Ziprin P, Ridgway PF, Peck DH, Darzi AW. Laparoscopic-type environment enhances mesothelial cell fibrinolytic activity in vitro via a down-regulation of plasminogen activator inhibitor-1 activity. *Surgery* 2003;134:758-65.
 27. Korman U, Kurugoglu S, Ogut G. Conventional enteroclysis with complementary MR enteroclysis: a combination of small bowel imaging. *Abdom Imaging* 2005;30:564-75.
 28. Francois Y, Mouret P, Tomaoglu K, Vignal J. Postoperative adhesive peritoneal disease. Laparoscopic treatment. *Surg Endosc* 1994;8:781-3.
 29. Malik E, Berg C, Meyhöfer-Malik A, Haider S, Rossmannith WG. Subjective evaluation of the therapeutic value of laparoscopic adhesiolysis: a retrospective analysis. *Surg Endosc* 2000;14:79-81.