Int J Clin Exp Med 2019;12(4):3750-3757
www.ijcem.com /ISSN:1940-5901/IJCEM0088498

Original Article

Application of initiative content reduction surgery in the treatment of abdominal giant hernia in experimental rabbits

Hao Wang[1*], Shuo Yang[1*], Xingxia Zhong[2], Zhenyu Zou[1], Cuihong Jin[1], Minggang Wang[1], Yingmo Shen[1], Jie Chen[1]

[1]Department of Hernia and Abdominal Wall Surgery, Beijing Chao-Yang Hospital, Beijing City, China; [2]Guangdong Guan Hao Biotechnology Co., Ltd., Guangzhou, Guangdong Province, China. [*]Equal contributors and co-first authors.

Received November 16, 2018; Accepted December 7, 2018; Epub April 15, 2019; Published April 30, 2019

Abstract: Objective: The goal of this study was to explore the effects of initiative content reduction surgery on prevention of intra-abdominal hypertension (IAH) after abdominal giant hernia repair in rabbits. Methods: Abdominal giant incisional hernia (AGIH) rabbit models were established and divided into group A and group B randomly. Rabbits in both groups were treated with herniorrhaphy, the hernia contents were completely returned during surgery in the group B, while the A group received partial resection of the greater omentum and then the hernia contents were completely returned. Intra-abdominal pressure (IAP), wound complications, and death were recorded and statistically analyzed before and after surgery in the both groups. Results: There was no significant difference in IAP between the two groups before surgery ($P > 0.05$). The results of 3 abdominal pressure examinations after surgery showed that group A was all significantly lower than group B (all $P < 0.05$). There was a significant correlation between the occurrence of wound dehiscence and the increase of IAP after surgery. Conclusion: Initiative content reduction surgery can effectively prevent the occurrence of IAH and abdominal compartment syndrome (ACS) after AGIH repair in rabbits, and has application value in the clinic.

Keywords: Abdominal hernia, initiative content reduction, experimental rabbit

Introduction

Incisional hernia is one of the common complications after abdominal surgery with an incidence of about 5%-10% [1]. The definition of abdominal giant incisional hernia (AGIH) is that the diameter of the abdominal wall defect exceeds 12 cm or the ratio of hernia sac volume to abdominal cavity volume is more than 15% [2]. The incidence of abdominal hernia has increased with the increase of abdominal surgery cases year by year. Take incisional hernia for example: according to statistics, 2%-10% of abdominal surgery can lead to incisional hernia [3]. When there is no incarceration after incisional hernia repair or if the patients have no symptoms, as the volume of hernia increases, incarceration occurs, and the contents of the original abdominal cavity gradually decrease, resulting in abdominal giant hernia. Moreover, in the case of incarceration, hernia contents (intestine, omentum, etc.) are prone to necrosis, which seriously affects the quality of life of patients and even threatens their lives. At present, surgery is the only effective treatment for AGIH. Because of the influence of many factors, such as old age or obesity, the recurrence rate is 10%-30% and the complication rate is 50% [4-7]. Among them, intra-abdominal hypertension (IAH) and abdominal compartment syndrome (ACS) are serious postoperative complications. The occurrence of IAH or ACS can cause adverse effects on the organs of the whole body, such as the decrease in returned blood volume and the reduction of lung volume caused by the elevation of the diaphragm, and further affect the function of the heart and lung [8]. In addition, the occurrence of IAH can stimulate the gastrointestinal tract to cause abdominal pain and diarrhea, and the blood supply of mesenteric artery and intestinal mucosa will decrease significantly under high pressure, and

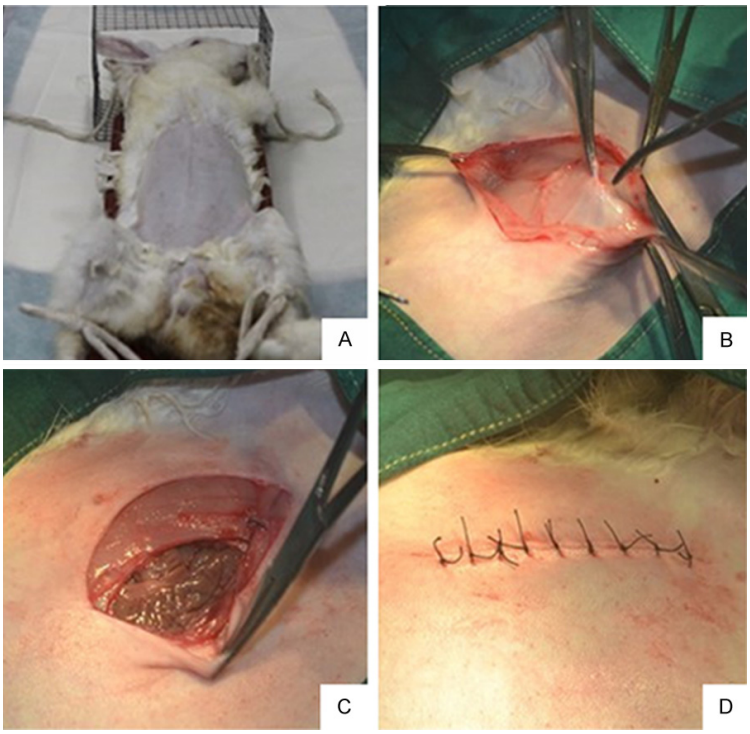

Figure 1. Surgical process of modeling A: Position; B: Exposed muscle; C: Establishment of muscular layer defect; D: Interrupted suture incision with silk thread.

the pH in intestinal mucosa will also decrease, then leading to the bacterial translocation or even sepsis [8]. Elevated abdominal pressure can lead to kidney and renal vein pressure, and activation of the renin-angiotensin-aldosterone system can cause oliguresis and water and sodium retention, thus leading to an aggravation of edema in abdominal organs. When abdominal pressure reaches a certain level, intracranial pressure will increase and cerebral blood perfusion pressure will decrease, which may be related to the pressure of the superior vena cava, obstruction of cerebral blood flow, and decreased cardiac output. The combination of these multiple conditions can eventually lead to multiple organ dysfunction or even death [9-11].

Patients with abdominal giant hernia are mostly elderly suffering from various underlying diseases. Postoperative occurrence of IAH or ACS will cause severe damage to all organs of these patients. Therefore, prevention of IAH in the perioperative period of AGIH becomes an essential part of the treatment. However, it is difficult for most patients with abdominal giant hernia to achieve prevention through weight control and abdominal wall compliance exercise. Some scholars suggest that partial resection of intestinal duct and greater omentum can prevent IAH and ASC after surgery [8]. In clinical practice, initiative content reduction surgery could significantly reduce the incidence of IAH and ACS after AGIH repair, and has a good curative effect and low recurrence rate in small sample studies at home and Abroad [12, 13]. However, this technique still lacks pro spective clinical control studies with large samples and evidence-based medicine research.Therefore, the effects of this technique on the prevention and treatment of IAH after AGIH repair were explored in this study by animal experiments.

Materials and methods

Main materials

Experimental rabbits (New Zealand white rabbit), aged 1 year old, weighing 3-5 kg, were provided by Animal experiment center of Guangdong Grandhope Biotechnology Co., Ltd. Bovine pericardial crosslinked biological patches (Guangdong Grandhope Biotechnology Co., Ltd.).

Animal modeling

One-year-old healthy rabbits were forbidden to eat and drink for 8 hours before surgery. One mL/kg of 3% pentobarbital sodium was intravenously injected through the ear margin for anesthesia. After anesthesia, the rabbits were fixed with a supine position, skin preparation, iodophor disinfection, and towel pavement was performed. A 5 cm longitudinal incision was made at a transverse finger near the left side of the median line of abdomen, and the skin and subcutaneous tissue were cut to expose the muscles. A muscle tissue with diameter of about 3 cm near the median line was resected (preserving the complete peritoneum). Skin and subcutaneous tissue were discontinuously sutured with silk thread, and closed with medical glue (**Figure 1**). Penicillin was orally adminis-

Figure 2. Abdominal giant incisional hernia model 1 month after surgery (supine position)

tered 3 days after surgery. The rabbits were raised by professionals in the animal experiment center of Guangdong Grandhope Biotechnology Co., Ltd. at the temperature of 25°C-30°C and relative humidity of 40%-60%, with discontinuous water feeding and free eating. The postoperative observation period was 1 month, and the wound healing, swelling, and abdominal mass bulging were observed. Abdominal incisional hernias occurred in all experimental rabbits within one month (about 8-10 cm in diameter) (**Figure 2**).

Animal grouping

A total of 100 AGIH model white rabbits were randomly divided into the experimental group (group A) and the control group (group B).

Herniorrhaphy and abdominal pressure measurement

After anesthesia, the rabbits were taken supine position, and the skin and subcutaneous tissue, muscular layer and peritoneum were punctured layer by layer with a sharp knife at the median line of the abdomen, about two transverse fingers below the mass. One end of the infusion tube was inserted into the abdominal cavity about 5 cm and fixed, and the head of the infusion tube ended with a saline bottle, which was about 100 cm higher than the pubic symphysis of the experimental rabbit. A total of 100 mL saline was injected into the abdominal cavity of the rabbit, and the saline at the end was removed. After the liquid level in the tube dropped to a stable level, the pressure value (cmH_2O) was collected at the end of inspiratory with pubic symphysis as the baseline. The skin and subcutaneous tissue were cut along the scar of the last surgery, and the hernia sac was exposed, completely separated, and opened along the median incision. Hernia contents of 50 rabbits in the group B were completely returned. circular resection of the hernial sac was performed along the hernia sac neck, peritoneum, and muscular coat were continuously sutured with absorbable lines, and then the hernia sac neck was closed. The myometrium around the hernia ring was pulled to the midline, and the muscular defect was closed by continuous suture. The bovine pericardial crosslinked biological patches were used to repair, the absorbable lines were fixed in the muscular coat, and the skin and subcutaneous tissue were sutured discontinuously (excision of excess skin). a total of 50 rabbits in the group A were resected with partial greater omentum (mainly hernia content omentum, slight adhesion of omentum, no other pathological changes), the hernia contents were returned, and the other operations were similar to group B. Postoperative abdominal pressure was measured in the same way (**Figure 3**).

Postoperative observation

The piezometer tube was kept for 2 days after surgery, and the abdominal pressure was measured daily by the method mentioned above. The wound local healing, swelling, patch infection, and mass bulging were observed. If there was wound dehiscence, re-surgery was performed to debridement and suture. The individual with visceral prolapse was returned the viscus and then debrided and sutured. The time and cause of death were recorded.

Statistical analysis

SPSS 19.1 Statistical Software was used for statistical analysis. The measurement data are expressed by mean ± standard deviation ($\bar{x}$ ± sd), and the changes of abdominal pressure between the two groups before and after surgery were compared by t test. The counting data are expressed by rate, and the abdominal pressure between the two groups before and after surgery was analyzed and compared by rank sum test. The incidence of wound dehis-

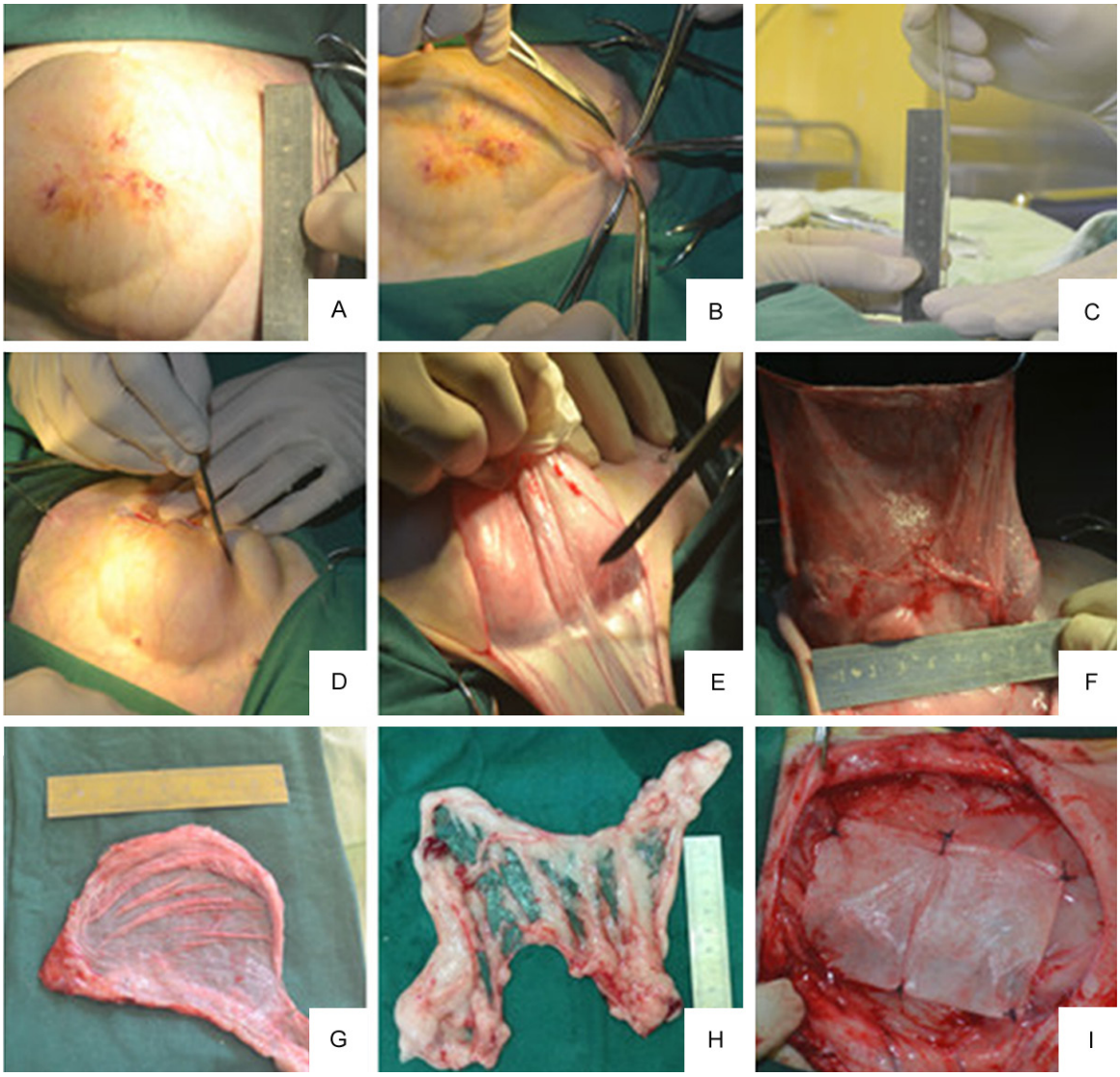

Figure 3. Herniorrhaphy Hernia repair and abdominal pressure measurement A: Abdominal hernia measurement; B: Pressure tap establishment; C: Abdominal pressure measurement; D: Skin and subcutaneous tissue incision; e: Hernia sac separation; f: Hernia sac measurement; G: Resected hernia sac; H: Resected greater omentum in the group B; I: Biological patch placement and fixation.

cence within one month after surgery was analyzed and compared with Chi-square test. The correlation between wound dehiscence and postoperative abdominal pressure was analyzed by binary logistic regression analysis. When $P < 0.05$, the difference was statistically significant.

Results

Results of abdominal pressure measurement

There was no significant difference in abdominal pressure between the two groups before surgery ($P > 0.05$). The abdominal pressure in group B was higher than that in group A on day 0,1, and 2 after surgery, and the difference was statistically significant (all $P < 0.05$) (**Table 1**). The abdominal pressure in the two groups after surgery was significantly higher than that before surgery, and the difference was statistically significant ($P < 0.05$) (**Figure 4**). The abdominal pressure in group A was significantly lower than that in group B on the day of the surgery (**Figure 5**).

Postoperative complications

Wound healing of experimental rabbits was observed within one month after surgery. In group B, there were 11 cases of wound dehis-

Table 1. Average abdominal pressure (cmH_2O, $\bar{x} \pm sd$)

Group	Before surgery (D)	Surgery day (D0)	1 day after surgery (D1)	2 days after surgery (D2)
Group A	5.05 ± 0.54	5.25 ± 0.54	5.15 ± 0.54	5.10 ± 0.51
Group B	4.93 ± 0.52	6.99 ± 0.65	7.09 ± 0.76	7.13 ± 0.67
t	1.139	14.371	14.615	16.820
P	0.257	< 0.001	< 0.001	< 0.001

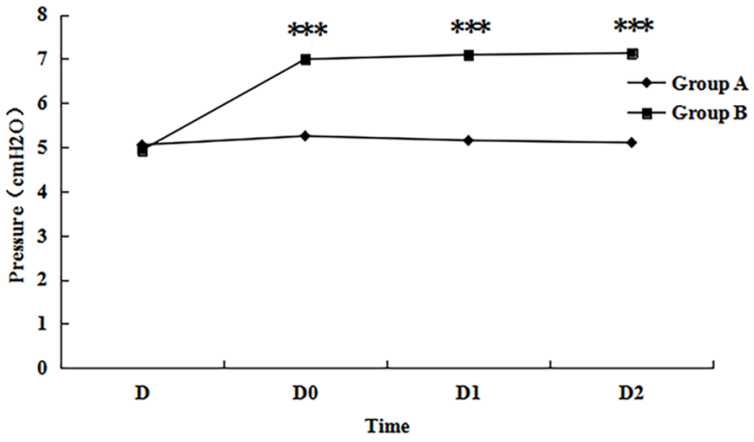

Figure 4. Varying curve of abdominal pressure in group A and group B D: before surgery; D0: the surgery day; D1: 1 day after surgery; D2: 2 days after surgery; *** was P<0.001.

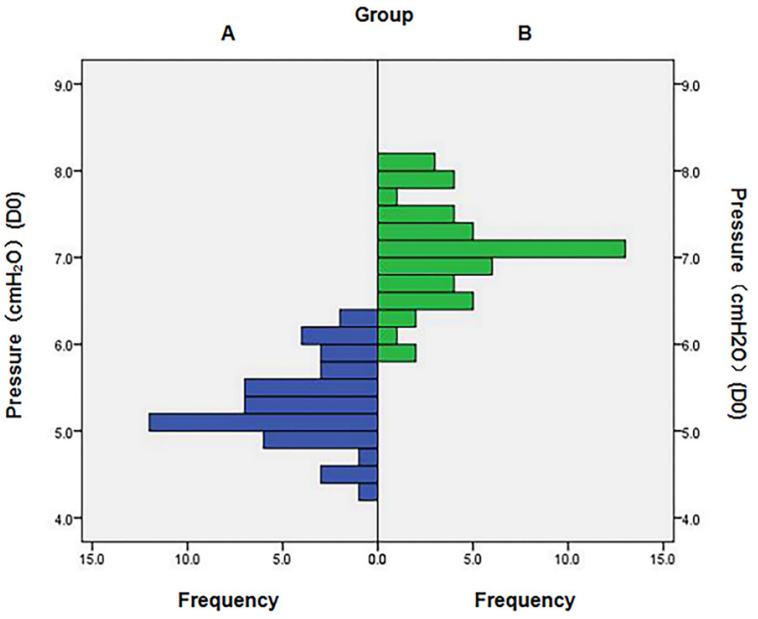

Figure 5. Comparison of abdominal pressure distribution between two groups of rabbits on the surgery day D0: the surgery day.

cence, among which 9 cases had visceral prolapse and died, and the incidence of wound dehiscence was 22.0%. In group A, there were 2 cases of wound dehiscence, no visceral prolapse and death, and the incidence of wound dehiscence was 4.0%. Chi-square test showed that there were significant differences in the incidence of wound dehiscence between the two groups. There were 9 rabbits in group B that died 8-20 days after surgery, and all of them had visceral prolapse, intestinal dilatation, and tissue edema. Only 1 case died of anesthesia accident in the group A (**Table 2**). In addition, the experimental rabbits in the both groups had normal diet and defecation after surgery. Additionally, a few of them showed obvious edema but recovered without special treatment. No patch infection or incisional hernia recurrence was found in all subjects. Patch specimens were taken out 1 month later, and patches in all surviving individuals were in good condition.

Death of mice was taken as dependent variable, and abdominal pressure as independent variable, and the mean abdominal pressure in group B was about 7 cmH_2O. Analysis of the assignment (abdominal pressure > 7 = 1, and ≤ 7 cmH_2O = 0) by binary logistic regression analysis showed a significant correlation between death and abdominal pressure on day 0, 1, and 2 after surgery (**Table 3**).

Discussion

Patients with abdominal giant hernia have a very long history, are often severely obese, and are associated with a variety of chronic diseases [4, 5]. In this case, if the contents of the hernia are completely returned during surgery, combined with postoperative gastrointestinal deterioration, postoperative fluid resuscitation,

Table 2. Wound condition and death condition

Group	Wound dehiscence	No wound dehiscence	Death	Survival
Group A	2	48	1	49
Group B	11	39	9	41
t	6.966		5.156	
P	0.008		0.023	

Table 3. Binary regression analysis of death and intra-abdominal hypertension

	B	SE	Wald	df	P	CI (95% confidence interval)
Surgery day	1.962	0.801	5.991	1	0.014	1.478-34.210
1 day after surgery	3.083	1.118	7.607	1	0.006	2.440-195.075
2 days after surgery	1.825	0.795	5.265	1	0.022	1.305-29.459

abdominal compliance decrease and other factors, the postoperative IAP will be significantly increased, which can further lead to IAH, and cause multiple organ damage such as heart, lung, kidney, brain, and even multiple organ failure (MOF) [14]. Moreover, IAH can easily develop to ACS that is hard to treat and with a high mortality (60%-70% reported abroad) [15, 16]. Studies on the IAP have found that the curve of abdominal pressure/volume was not a straight line. When the volume reaches a certain value, if the volume continues to increase, the abdo inal pre sure will increase steeply, on the contrary, volume reduction can significantly reduce abdominal pressure [17]. A retrospective analysis from 2011 to 2013 showed that in obese patients with AGIH repair, the use of initiative content reduction and primary repair with biological patches could effectively reduce postoperative abdominal pressure, thus achieving the purpose of preventing IAH. Furthermore, it can reduce the incidence of postoperative complications by reducing postoperative BMI [18]. However, due to ethical reasons, the technique is still lack of prospective control study. Therefore, in this experiment, rabbits with similar abdominal wall structure to human were selected as experimental objects to explore the effects of initiative content reduction surgery on the prevention and treatment of IAH after abdominal giant hernia repair [19].

On the basis of the previous theories and the practices of small samples, the new surgical methods and new materials, which often need to be verified by animal experiments in clinic, were used in this study. The use of animal models makes the appearance of rare diseases in the human body to be well simulated and has a positive and important significance in the completion of the process of disease development and treatment [20, 21]. The results of this study showed that during the abdominal giant hernia repair in experimental rabbits, the complete return of hernia contents resulted in a significant increase in postoperative abdominal pressure, which is consistent with the conclusion of clinical retrospective study. In clinical practice, IAH was found in all abdominal giant hernia patients with complete return of herniation contents during surgery. In addition, postoperative fluid resuscitation and intestinal edema, hypofunction resulted in an increase in the contents of the abdominal cavity, and forced closure of the abdominal cavity after resection of the hernia sac resulted in a decrease in the abdominal volume, implantation of artificial materials. Abdominal muscle tension caused by postoperative pain and postoperative abdominal band protection resulted in lower abdominal compliance. The combined effects of these factors eventually led to a sharp increase in abdominal pressure in patients. Clinically, increased abdominal contents, reduced abdominal volume or decreased abdominal compliance may lead to IAH. Additionally, intra-abdominal infection, abdominal aortic aneurysm rupture, intestinal obstruction, severe abdominal trauma, retroperitoneal hemorrhage, pneumoperitoneal laparoscopic surgery, acute pancreatitis and abdominal giant hernia surgery are common surgical causes [22]. All kinds of patches are widely used in the treatment of abdominal hernia, and in this experiment, the bovine pericardial crosslinked biological patches were used to repair [23-25]. The suture of hernia in both groups was performed by patches with appropriate size for hernia, because studies have found that the appropriate size of patches can reduce complications [26] and influence of patch size was excluded in this study. Nine cases died in the group without volume reduction during postoperative observation, all of

them had wound dehiscence and visceral prolapse, accompanied by severe intestinal edema. Statistical analysis showed that there was a significant correlation between wound complications and abdominal pressure, so the cause of death was wound dehiscence caused by IAH. The increase of abdominal pressure can reduce the blood supply of the abdominal wall by reducing cardiac output and increasing abdominal blood flow resistance. Some studies have shown that IAH can prolong stitch removal time of abdominal incision [27]. The use of initiative content reduction during the surgery can greatly reduce postoperative abdominal pressure, which is consistent with the clinical findings [18]. The incidence of wound complications in the experimental group was significantly lower than that in the control group, indicating that the initiative content reduction surgery can reduce the wound dehiscence and visceral prolapse by reducing the postoperative abdominal pressure, thereby reducing the postoperative mortality.

The observation period of this experiment was relatively short, and the complications after surgery might not be comprehensive. Moreover, due to limited funds, the function of related organs was not tested. The intestinal duct was not resected in the initiative content reduction surgery because of its high difficulty of operation, thus, the safety of primary repair with biologic patches needs to be further studied in animal experiments. In the following experimental study, the safety of primary repair with patches was explored after partial intestinal excision by initiative content reduction surgery and the effect of initiative content reduction surgery on the long-term prognosis of abdominal giant hernia.

In conclusion, initiative content reduction surgery can effectively prevent the occurrence of IAH and ACS after AGIH repair in rabbits, and has application value in the clinic.

Acknowledgements

This work was supported by Clinical Techn ology Innovation Project of Beijing Municipal Administration of Hospitals (XMLX201602) and Beijing Municipal High-level Health Technology Personnel Training Project (2015-3-031).

Disclosure of conflict of interest

None.

Address correspondence to: Yingmo Shen, Department of Hernia and Abdominal Wall Surgery, Beijing Chao-Yang Hospital, No.5 Jingyuan Road, Shijingshan District, Beijing City 100043, China. Tel: +86-13501074480; E-mail: shenyingmo7649@163.com; Jie Chen, Department of Hernia and Abdominal Wall Surgery, Beijing Chao-Yang Hospital, No.5 Jingyuan Road, Shijingshan District, Beijing City 100043, China. Tel: +86-010-51718704; E-mail: chenjie2673@163.com

References

[1] Faylona JM. Evolution of ventral hernia repair. Asian J Endosc Surg 2017; 10: 252-258.
[2] Hernia and abdominal surgery group of Chinese medical Association external medicine branch, Chinese college of surgeons, Chinese hernia college of surgeons. Guidelines for diagnosis and treatment of abdominal-incisional hernia. Chinese Journal of Surgery 2014; 52: 487-489.
[3] Ellison EC, Zollinger RM Jr. Zollinger's Atlas of surgical operations. Peking University Medical Press 2017.
[4] Hodgkinson JD, Maeda Y, Leo CA, Warusavitarne J, Vaizey CJ. Complex abdominal wall reconstruction in the setting of active infection and contamination: a systematic review of hernia and fistula recurrence rates. Colorectal Dis 2017; 19: 319-330.
[5] Alaedeen DI. Introduction and epidemiology of incisional hernias and the argument for mesh in incisional hernia repair. Springer International Publishing 2017.
[6] Emile SH, Elgendy H, Sakr A, Gado WA, Abdelmawla AA, Abdelnaby M, Magdy A. Outcomes following repair of incarcerated and strangulated ventral hernias with or without synthetic mesh. World J Emerg Surg 2017; 12: 31.
[7] Bikhchandani J, Fitzgibbons RJ Jr. Repair of giant ventral hernias. Adv Surg 2013; 47: 1-27.
[8] Leng Y, Yi M, Fan J, Bai Y, Ge Q, Yao G. Effects of acute intra-abdominal hypertension on multiple intestinal barrier functions in rats. Sci Rep 2016; 6: 22814.
[9] Roberts DJ, Waele JJD, Kirkpatrick AW and Malbrain MLNG. Intra-abdominal hypertension and the abdominal compartment syndrome. Springer International Publishing 2016.
[10] Filipović-Grcić I, Bogović-Zah Tatjana, Luetić T, Vuković J, Novak M, Perić M. Influence of intraabdominal hypertension in preoperative, intraoperative and postoperative process of liver transplantation in children. Abstract book 6th Croatian Congress of Pediatric Surgery 2011.
[11] Yang B, Wu ZX, Song XH. Advances in pathophy siology of abdominal hypertension. Geriatrics & Health Care 2016; 22: 320-322.

[12] Renard Y, Lardière-Deguelte S, de Mestier L, Appere F, Colosio A, Kianmanesh R, Palot JP. Management of large incisional hernias with loss of domain: a prospective series of patients prepared by progressive preoperative pneumoperitoneum. Surgery 2016; 160: 426-435.

[13] Yang S, Chen J, Cao JX, Liu YC. Application value of initiative content reduction surgery in the prevention and treatment of postoperative intra-abdominal hypertension of obese patients with giant ventral hernia. Chinese Journal of Digestive Surgery 2016; 15: 957-960.

[14] Mavrodin CI, Pariza G, Ion D and Antoniac VI. Abdominal compartment syndrome--a major complication of large incisional hernia surgery. Chirurgia 2013; 108: 414.

[15] Al Skaini MS, Sardar A, Haroon H, Al Ghamdi SM, Homran A and Rabie ME. Traumatic diaphragmatic hernia: delayed presentation with tension viscerothorax--lessons to learn. Ann R Coll Surg Engl 2013; 95: e27.

[16] Kirkpatrick AW, Roberts DJ, De Waele J, Jaeschke R, Malbrain ML, De Keulenaer B, Duchesne J, Bjorck M, Leppaniemi A, Ejike JC, Sugrue M, Cheatham M, Ivatury R, Ball CG, Reintam Blaser A, Regli A, Balogh ZJ, D'Amours S, Debergh D, Kaplan M, Kimball E, Olvera C; Pediatric Guidelines Sub-Committee for the World Society of the Abdominal Compartment Syndrome. Intra-abdominal hypertension and the abdominal compartment syndrome: updated consensus definitions and clinical practice guidelines from the World Society of the Abdominal Compartment Syndrome. Intensive Care Med 2013; 39: 1190-1206.

[17] Li YK, Tang JD, Wu ZJ, Zhang QQ, Yu YN, Liu LL, Zhang LN, Wang FF, Pang L, Zhang SZ. Effect of enema on intra-abdominal pressure. Journal of Clinical Radiology 2010; 29: 250-252.

[18] Han XF, Chen J, Shen YM, Chen FQ, Liu SJ, Wang MG, Yang S. Initiative volume reduction surgery performed in huge ventral incisional hernia of obese patients. Chinese Journal of Hernia and Abdominal Wall Surgery (Electronic Version) 2015: 20-22.

[19] Chen SY, Zhao Y, Meng XY, Zhang HL. Establishment of rabbit abdominal wall hernia model and study of its criteria. Journal of Chongqing Medical University 2014; 39: 1321-1324.

[20] Gullbrand SE, Malhotra NR, Schaer TP, Zawacki Z, Martin JT, Bendigo JR, Milby AH, Dodge GR, Vresilovic EJ and Elliott DM, Mauck RL, Smith LJ. A large animal model that recapitulates the spectrum of human intervertebral disc degeneration. Osteoarthritis Cartilage 2017; 25: 146-156

[21] Kalaba S, Gerhard E, Winder JS, Pauli EM, Haluck RS, Yang J. Design strategies and applications of biomaterials and devices for hernia repair. Bioact Mater 2016; 1: 2-17.

[22] Lei H. Management of abdominal hernias (4th edition). Edited by Lei H. Shanghai Scientific & Technical Publishers 2014.

[23] Holihan JL, Bondre I, Askenasy EP, Greenberg JA, Keith JN, Martindale RG, Roth JS, Liang MK; Ventral Hernia Outcomes Collaborative (VHOC) Writing Group. Sublay versus underlay in open ventral hernia repair. J Surg Res 2016; 202: 26-32.

[24] Schwarz J, Reinpold W, Bittner R. Endoscopic mini/less open sublay technique (EMILOS)-a new technique for ventral hernia repair. Langenbecks Arch Surg 2017; 402: 1-8.

[25] Wormer BA, Clavin NW, Lefaivre JF, Korn JM, Teng E, Aukskalnis AS and Robinson JM. Reducing postoperative abdominal bulge following deep inferior epigastric perfor ator flap breast reconstruction with onlay monofilament Poly-4-Hydroxybutyrate biosynthetic mesh. J Reconstr Microsurg 2016; 33: 008-018.

[26] Kokotovic D, Bisgaard T, Helgstrand F. Long-term recurrence and complications associated with elective incisional hernia repair. JAMA 2016; 316: 1575.

[27] Xu PJ, Cao JE, Liu Y, Kou QY. Effect of intra-abdominal hypertension on severe gastrointestinal surgery patients. Journal of Nurses Training 2013; 28: 1714-1716.