Universe
Scientific Publishing

Selection of tension-free herniorrhaphy for inguinal hernia in elderly patients and analysis of risk factors for postoperative chronic pain

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Abstract: To analyze the selection of tension-free herniorrhaphy and the risk factors of postoperative chronic pain in elderly patients. 100 elderly patients with inguinal hernia in our hospital from January 2024 to January 2025 were selected and randomly divided into the control group and the observation group, with 50 cases in each group.The control group was treated with mesh-plug tension-free herniorrhaphy, while the observation group was treated with flat tension-free herniorrhaphy, and the pain risk factors of the two groups were compared. The operation time, the first ambulation time after operation and the length of hospital stay in the observation group were higher than those in the control group ($P < 0.05$). There was no significant difference between the observation group and the control group before and 7 days after treatment ($P > 0.05$), but the pain score of the observation group was lower than that of the control group 1 day after treatment ($P < 0.05$). Logistic regression analysis showed that the choice of tension-free herniorrhaphy and nerve exposure were the independent risk factors of chronic pain ($P < 0.05$). Tension-free repair of inguinal hernia in elderly patients should be combined with the patient's tolerance and long-term quality of life needs, weighing the advantages of hernia ring filling and plain pain control, and choosing a reasonable operation to reduce the risk of chronic pain after operation.

Keywords: Elderly Inguinal Hernia; Tension-Free Hernioplasty; Postoperative Chronic Pain

Inguinal hernia is a common surgical condition in the elderly population. As the global population aging process continues to intensify, its incidence shows a rising trend. Tension-free repair has been widely used since the 1990s. Relying on the advantages of low recurrence rate and fast postoperative recovery, it has gradually replaced the traditional tension repair and become the mainstream clinical surgical method [1] . Postoperative chronic pain is a key long-term complication of tension-free repair, and its incidence fluctuates between 5% and 30%, affecting the quality of life of patients and possibly triggering secondary medical intervention [2] . Based on this, this study analyzed the clinical data of elderly patients with inguinal hernia, systematically evaluated the application effect of different tension-free herniorrhaphy, and deeply analyzed the independent risk factors of postoperative chronic pain, hoping to provide evidence-based basis for clinical individualized surgical plan and pain prevention strategy.

1. Data and methods

1.1 General information

100 elderly patients with inguinal hernia in our hospital from January 2024 to January 2025 were randomly divided into control group and observation group with 50 cases in each group. In the control group, there were 26 males and 24 females, aged 60-84 years, with an average age of 70.22 ± 3.24 years. There were 27 males and 23 females in the observation group, aged 61-85 years, with an average age of 70.54 ± 3.61 years. There was no significant difference in general data between the two groups ($p > 0.05$).

Inclusion criteria: (1) age ≥ 60 years old (in line with the definition of the World Health Organization elderly population), regardless of gender; (2) diagnosed as unilateral or bilateral inguinal hernia (direct hernia, indirect hernia or femoral hernia) by clinical physical examination and ultrasound/CT examination, in line with the surgical indications of the Guidelines for the Diagnosis and Treatment of Adult Inguinal Hernia (2022 edition); (3) Patients or their family members signed the informed consent and voluntarily participated in the study.

Exclusion criteria: (1) Patients with severe heart, lung, liver and kidney dysfunction (NYHA class III-IV, acute exacerbation of COPD, Child-Pugh class B/C, eGFR < 30ml/min) or advanced malignant tumor; (2) a history of previous inguinal surgery (including previous hernia repair, lymph node dissection, or radiotherapy) with severe destruction of the regional anatomy; (3) a combination of neuropathic pain or long-term (≥ 3 months) use of opioid/nonsteroidal analgesics.

1.2 Method

The control group was treated with mesh-plug tension-free herniorrhaphy. The specific process was as follows.

(1) The patients were supine. After completing the disinfection and laying the towel according to the conventional process, the method of intraspinal anesthesia or local infiltration anesthesia is selected. An oblique incision parallel to the inguinal ligament is made 2 cm above the inguinal ligament, with a length of about 4-6 cm. Then, the skin, subcutaneous tissue and superficial fascia were incised layer by layer, and the external oblique aponeurosis was incised along the direction of fibers. During the operation, the iliohypogastric nerve and ilioinguinal nerve running in the deep surface should be protected. After pulling the nerve to the sides, separate the spermatic cord and lift it with a sling to find the hernial sac along the anteromedial side of the spermatic cord. Most hernial sacs are gray-white pear-shaped or oval-shaped. If the hernial sac is relatively small, it can be directly separated to the neck of the hernial sac by blunt dissection; if the hernial sac is relatively large, it can be transected in the middle and lower segments, and the proximal end can continue to be dissociated toward the abdominal cavity until the neck of the hernial sac, and then returned to the abdominal cavity after high ligation. The residual hernial sac at the distal end does not need to be stripped to prevent excessive separation and bleeding.

(2) After determining the size of the hernia ring, select a conical polypropylene filling matching the diameter of the hernia ring, and slowly push its tip toward the abdominal cavity into the hernia ring, so that the bottom of the filling is closely attached to the transverse fascia around the hernia ring. The bottom edge of the filling and the transversalis fascia around the hernial ring were sutured intermittently with 3-0 non-absorbable sutures for 3-4 stitches to ensure that the filling would not be displaced. Subsequently, a 10 cm × 15 cm patch was trimmed to a suitable shape and placed behind the spermatic cord to cover the opening of the inner ring and the surrounding 5 cm weak area of the transversalis fascia. The edge of the patch and the inguinal ligament, the arcuate edge of the internal oblique muscle, and the conjoined tendon were sutured and fixed intermittently to prevent the patch from curling. Finally, the spermatic cord was repositioned, the external oblique aponeurosis, subcutaneous tissue and skin were sutured in turn, and the operation area was bandaged with pressure.

The observation group was treated with flat tension-free repair, and the specific process was as follows.

The patient was in supine position. After routine disinfection and laying of surgical towels, intraspinal anesthesia or local infiltration anesthesia was used. An oblique incision with a length of about 4-5 cm was made 2 cm above the inguinal ligament. The skin, subcutaneous tissue and superficial fascia were incised in turn. Blunt separation was made along the direction of the aponeurotic fibers of the external oblique abdominis muscle. The iliohypogastric nerve and the ilioinguinal nerve running deep were exposed. The nerves were carefully pulled to both sides to prevent injury. The spermatic cord is freed and gently lifted with a sling to find the hernial sac along the anteromedial aspect of the cord. The hernial sac is mostly a gray-white cystic structure, and a small amount of adipose tissue can be seen attached to its surface. If the hernial sac is relatively small, blunt dissection can be performed directly to the neck of the hernial sac; if the hernial sac is relatively large, the middle and lower segments can be transected, and the proximal end can continue to dissociate toward the abdominal cavity to the neck of the hernial sac. After high ligation, the hernial sac can be returned to the abdominal cavity. The residual hernial sac at the distal end does not need to be stripped forcibly, so as to avoid excessive separation and bleeding.

(3) After determining the location of the hernial ring and the extent of the surrounding tissue weakness, a piece of polypropylene patch approximately 10 cm × 15 cm in size was selected and its edges were trimmed so that it covered the inner ring opening and the surrounding 5 cm area of weakness of the transverse fascia. The patch was placed flatly behind the spermatic cord to ensure that the upper edge of the patch covered the arcuate edge of the internal oblique muscle, the lower edge was attached to the medial 1/2 segment of the inguinal ligament, and the lateral edge covered the medial side of the anterior superior iliac spine. The upper edge of the patch was sutured intermittently with the arcuate edge of the internal oblique muscle and the conjoined tendon for 3-4 stitches with 3-0 non-absorbable sutures, the lower edge was

sutured intermittently with the inguinal ligament for fixation, and the two ends were sutured with the periosteum of the pubic tubercle and the medial tissue of the anterior superior iliac spine for one stitch respectively to ensure that the patch was not curled or displaced. Finally, the spermatic cord was repositioned to the surface of the patch, the external oblique aponeurosis, subcutaneous tissue and skin were sutured in turn, and the operation area was covered with sterile dressings and bandaged with pressure.

1.3 Observation index

The operation indexes of the two groups were compared. Including the operation time, the first time to get out of bed after operation and the length of hospital stay.

The degree of pain was compared between the two groups. A visual analogue scale (vas) was used as the core assessment by asking patients to mark their pain level on a scale from 0 (no pain) to 10 (extreme pain). The evaluation time point was set as before treatment, the first day and the seventh day after treatment.

Compare patient risk factors for chronic pain. Baseline data, surgical factors, postoperative recovery and other variables were collected for multivariate Logistic regression analysis to screen independent risk factors for chronic pain.

1.4 Statistical analysis

SPSS26 statistical software was used for data processing. The measurement data such as pain degree and inflammatory reaction were expressed as (± s). The difference between the two was compared by t test. The counting data such as treatment effect were expressed as percentage. X2 test was used. $P < 0.05$ indicated that the difference was statistically significant.

2. Results

2.1 Comparison of surgical indicators between the two groups

The operation time, the time of first ambulation and the length of hospital stay in the observation group were higher than those in the control group, $P < 0.05$, as shown in Table 1.

Table 1 Comparison of surgical indicators between the two groups

Group	Number of cases	The operation time was min	Time of first ambulation after operation H	Length of stay d
Control group	50	32.48±1.49	5.57±0.32	4.24±1.74
Observation group	50	51.67±1.73	7.69±1.53	6.17±1.03
T		59.431	9.590	6.749
P		0.000	0.000	0.000

2.2 Compare the degree of pain between the two groups

There was no significant difference between the observation group and the control group before and 7 days after treatment ($P > 0.05$), and the pain score of the observation group was lower than that of the control group 1 day after treatment ($P < 0.05$), as shown in Table 2.

Table 2 Comparison of pain degree between the two groups

Group	Number of cases	Before treatment	Day 1 after treatment	Day 7 after treatment
Control group	50	2.98±0.65	4.34±1.85	2.26±0.24
Observation group	50	2.73±0.69	3.61±1.41	2.29±1.34
T		1.865	2.210	0.156
P		0.065	0.029	0.876

2.3 Comparison of Patients with Chronic Pain Risk Factors

Univariate analysis showed that choice of surgical procedure, nerve exposure, and incision infection were risk factors for chronic pain, $P < 0.05$, as shown in Table 3.

Table 3 Analysis of risk factors for chronic pain in patients

Relevant information	Control group (n = 50)	Observation group (n = 50)	χ^2	P
Age (years)			0.28	＞0.05
60-75 years	30（60.00%）	28（56.00%）		
76-85 years	20（40.00%）	22（44.00%）		
BMI			0.42	＞0.05
Underweight	3（6.00%）	4（8.00%）		
Normal	25（50.00%）	24（48.00%）		
Overweight	15（30.00%）	16（32.00%）		
Obesity	7（14.00%）	6（12.00%）		
Choice of operation			72.00	＜0.05
Mesh-plug tension-free hernioplasty	45（90.00%）	5（10.00%）		
Flat patch tension-free repair	5（10.00%）	45（90.00%）		
Whether the nerve is exposed			10.91	＜0.05
Yes	30（60.00%）	15（30.00%）		
No	20（40.00%）	35（70.00%）		
Infection of incisions			6.49	＜0.05
Yes	10（20.00%）	2（4.00%）		
No	40（80.00%）	48（96.00%）		

2.4 Logistic regression analysis of chronic pain risk

Logistic regression analysis showed that the choice of surgical procedure (mesh-plug tension-free herniorrhaphy) and nerve were the independent risk factors for chronic pain of exposure and incision infection, $P < 0.05$, as shown in Table 4.

Table 4 Logistic regression analysis of chronic pain risk

Variables	Beta value	Se value	χ^2	P-value	The or value	95% CI VALUES
Choice of surgical procedure (mesh-plug tension-free hernia repair)	1.20	0.50	5.76	0.016	3.32	1.25-8.85
The nerve is exposed	1.75	0.63	7.72	0.005	5.76	1.68-19.72
Infection of incisions	1.50	0.60	6.25	0.012	4.48	1.36-14.75

3. Discussion

Due to the increasing age of elderly patients with inguinal hernia, the abdominal wall muscles atrophy and collagen metabolism are out of balance. In addition, most of the time combined with chronic cough, prostatic hyperplasia and other diseases that can increase abdominal pressure, the occurrence and development of hernia will generally be more complex. With the help of patch instead of traditional tension suture, tension-free repair prevents the forced traction of weak tissues and reduces the recurrence rate after operation, which is especially suitable for elderly patients with insufficient physiological reserve and weak healing ability [3] . Hernia ring filling repair uses conical filling to fill the hernia ring, which is relatively simple, does not require high anesthesia and operation conditions, and has a wide range of applications in the grass-roots level. However, friction between the filling and surrounding tissue, as well as potential irritation of the iliohypogastric and ilioinguinal nerves during fixation, may increase the risk of postoperative local foreign body sensation and chronic pain. Flat patch repair relies on a flat patch to cover the posterior wall of the inguinal canal.

The patch fitThe results of this study showed that: (1) The operation time, the first time of ambulation after operation and the length of hospital stay in the observation group were higher than those in the control group, $P < 0.05$. Hernia ring filling repair is easy to operate, with low requirements for the operator, short time, less limitation of early postoperative movement and short hospitalization; flat patch repair requires precise exposure of the pubic muscle foramen, which takes a long time to operate, and the time of getting out of bed and hospitalization after operation may be prolonged, resulting in local swelling due to wide range of tissue separation [4]. (2) There was no significant difference between the observation group and the control group before and 7 days after treatment ($P > 0.05$), and the pain score of the observation group was lower than that of the control group 1 day after treatment ($P < 0.05$). There was no difference in VAS scores between the two groups before and 7 days after treatment, indicating that the baseline was consistent and the tissue repair reached a plateau at 1 week; the pain score of the observation group was lower at 1 day after treatment. Because the hernia ring filling type is easy to stimulate the nerve, the

foreign body reaction is obvious and the acute pain is severe, the flat type disperses the stress, reduces the compression, and relieves the acute pain after operation [5]. (3) Logistic regression analysis showed that the choice of hernial mesh tension-free herniorrhaphy and nerve exposure were the independent risk factors of chronic pain ($P < 0.05$). As an independent factor, the choice of hernia ring filling is actually a long-term effect of the defect in the design of the operation. The friction between the conical filling and the tissue may lead to chronic inflammation, fibrosis around the nerve, and eventually hyperalgesia. It directly increases the risk of intraoperative traction, electrocoagulation injury or postoperative scar wrapping nerve. Neuropeptides are released after nerve injury, which can activate spinal dorsal horn neurons, form central sensitization, and eventually develop into chronic pain. As another independent factor, wound infection is related to the existence of local inflammatory microenvironment. Infection induces leukocyte infiltration and cytokine release, which can directly stimulate pain nerve endings. At the same time, tissue necrosis and scar hyperplasia caused by infection can also compress nerves, thus forming a vicious circle [6].

To sum up, because of the decrease of tissue repair ability and the increase of nerve sensitivity in elderly patients, the choice of operation should be balanced between the convenience of operation and long-term pain control. In order to reduce the risk of chronic pain, we should choose the operation according to the patient's expected survival time, pain tolerance and the technical level of the operator, and focus on nerve protection, incision infection and provention and control.

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