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# Study on the relationship between right inguinal hernia (RIH) and appendectomy with laparoscopic and open surgery by McBurney incision

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**KEYWORDS**

Appendicitis, Right Inguinal Hernia, McBurney Incision, Laparoscopy

**A B S T R A C T**

Appendectomy is performed by open surgical technique (McBurney) and laparoscopy. Laparoscopic method is used in 58% of US appendectomies. Incisional hernias, occur to the nearby of surgical site due to previous surgery. Around 10-15% of abdominal Incisions lead to Incisional hernia. Considering the lack of new studies in this area and that no study has compared this two surgical techniques, we decided to determine the prevalence of right inguinal hernia (RIH) in patients undergoing open and laparoscopic appendectomy. All patients undergoing appendectomy referred to Khorramabad Shohada hospital were studied in a Cross Sectional Study from 2012 to 2014. The sample size was 264 patients in two groups of McBurney (136 patients) and laparoscopic (128) were enrolled with the inclusion criteria and randomly. Questionnaires were completed based on demographic information and questions related to the study by patients file, visiting and making call. For statistical analysis chi-square test and logistic regression for multivariate (at a significance level of less than 0.05) were used. Of total 162 person (4.61%) were men and 102 (6.38%) were female. The average age of the participants was 32 ± 9.10 years. Appendicitis leading to abscess in 5.4%, suppurative appendicitis in 8.70%, Phlegmon in 9.18% and perforated appendicitis were seen in 7.5% of the patients respectively. Right inguinal hernia in McBurney group were 6.6% (n = 9) and in laparoscopy group were 6.1% (n = 2). Despite the high incidence of hernia in McBurney group but there was no statistically significant relationship between the type of surgical procedure, type of appendicitis and the RIH. Other studies with larger sample sizes are recommended for further investigation.

## Introduction

Appendicitis, or the appendix worm-shaped appendage inflammation, is among the most common causes of acute abdomen and the most common surgical emergency that requires surgical procedures (1). Appendicitis mostly occurs in the second or third decade of human life and it has a prevalence rate of approximately 233 in 100,000 people. It also is mainly prevalent in the 10-19 years age group and is mostly seen in men (with a man to woman ratio of 1:1.4) (2).

The accepted level of Non therapeutic Appendectomy Rate (NAR) differs by age and gender of patients. The level of Negative Appendectomy Rate is higher in women than men. Moreover, no significant difference has been seen between appendectomy NAR using the open and laparoscopic methods (3). The majority of surgeons use aggressive approaches. The level of negative appendectomies in the past was 15%, but currently the level of negative appendectomies has decreased to below 10% using imaging methods (4).

Most of the patients with acute appendicitis undergo surgical treatment and appendectomy is still the golden standard treatment. In a study on 243 patients (average age of 33 years) with non-complicated appendicitis, which was confirmed through preoperative CT-Scan, 20% of patients showed to have complicated appendicitis during surgery. Hence, preoperative CT-Scan fails to diagnose complicated appendicitis fully before nonsurgical treatments. 24% of patients that received nonsurgical treatment using antibiotics showed a need for surgery and appendectomy in the first year of treatment (5).

Although a group of patients with acute appendicitis, who received nonsurgical treatment, did not need surgery in the first year of treatment (58%), surgical treatment is preferred for most patients. The reason is that in a group of patients receiving pharmaceutical treatment this condition develops into complicated appendicitis and the recurrence rate increases considerably. In addition, nonsurgical treatment is accompanied by risks in the elderly and patients with immune deficiency (6). Appendectomy is an operation that is conducted using the convention open laparotomy or laparoscopy methods. Laparoscopy accounts for 58% of all of the appendicitis surgeries in USA (7-10).

The surgical approach to patients suspected of appendicitis is dependent on factors such as reliability of diagnosis, history of previous surgeries, surgeon's skill, and patient's age, gender, and physical condition. In a study that was carried out on 7446 patients it was indicated that the level of laparoscopy side effects declined considerably (10). Laparoscopy is the preferred approach to patients suspected of appendicitis with uncertain diagnosis, the elderly, obese patients, and patients with non-complicated appendicitis (11-13). In a study that was conducted using the meta-analysis method on 56 patients, no considerable difference was observed between the consequences of open surgery and laparoscopy (14).

Hernia is defined as the protrusion of an organ or part of an organ through the body wall containing that organ. Inguinal hernia is more common than other forms of hernia such as femoral and abdominal hernia (15). Hernias are divided into the groups of congenital and acquired hernia and their rate of incident different in women and men (16).

Hernias caused by incision (incisional hernia) are hernias that result from histories

of previous surgeries near the hernia site and the inability of fascia tissues to close the surgical site. Emergency surgeries increase the chance of occurrence of such hernias. About 10-15% of incisions on the abdomen lead to incisional hernias (17).

Incisional hernias normally occur during the first days following surgery and causes associated with the site of surgery (e.g. infection, pressure, and surgical technique) account for development of such hernias (18).

The inner ring of the inguinal canal is U shaped and its bending part extends to the aponeurosis of the transverse abdominal muscle. This coating forms the ring bed and is supported by an internal oblique muscle in the front. As a result, an efficient gate forms, which closes when the pressure inside the abdomen increases. Damage to the transverse abdominal muscle and transverse posterior fascia can stop the pressure-breaker mechanism in the inner ring and undermine the posterior wall of the Hesselbach triangle. The McBurney incision in open surgery is applied in parallel to the iliohypogastric nerve and if the fibers of the internal oblique muscle are cut, this never will be in danger. When the branches of this nerve are cut, muscle paralysis and finally hernia can be expected (19).

Considering the lack of new studies on this topic and the lack of comparison between the aforementioned two surgical methods in previous studies, we decided to examine the prevalence of inguinal hernia in patients undergoing appendectomy using the open and laparoscopic methods. The reason was that investigation into the incidence of hernia with laparoscopy can significantly contribute to the confirmation of the theory that advocates the effect of damaged nerve on development of hernia.

## Materials and Methods

In a cross-sectional study, all of the patients with appendicitis who visited the Khoramabad Shohada Hospital were studied after obtaining the required permissions for collecting data from the files of patients, who underwent appendectomy from 2012 to 2014 in the McBurney and laparoscopy groups. A checklist was prepared based on the demographic information and questions related to the study such as the following: history of congenital hernia, history of abdominal aortic aneurysm, history of intake of glucocorticoids, history of collage diseases, family history of hernia, pregnancy, coughing, chronic constipation, smoking, wound infection, and malnutrition. It is worth mentioning that the surgeries for both groups were performed by one surgeon. In this research, first 136 samples from the McBurney group and 136 samples from the laparoscopy group (which contained 220 patients) were obtained randomly. However, due to the incompleteness of some of the files and lack of cooperation of some samples regarding examinations and attendance, finally a total of 128 laparoscopy samples were prepared and the information was divided between the two groups.

## Statistical Analysis

The collected data were analyzed by SPSS-17 statistical software. The collected data were expressed as percentage and mean ± SD. Continuous (quantitative) variables were compared by Independent samples and Paired t test. Categorical (qualitative) variables were compared by contingency tables and Chi-square test or Fisher's exact test. P-value $\leq 0.05$ was considered statistically significant.

## Results and Discussion

In this cross-sectional study that was conducted on patients with inguinal hernia, who visited Khoramabad Shohada Hospital from 2012 to 2014, a total of 136 samples in the McBurney group and 128 samples in the laparoscopy group were examined.

In the McBurney group, 46 patients (33.8%) were female while in the laparoscopy group 56 patients (43.8%) were female and the rest of the patients were male in both groups (P=0.102). The two surgical groups were homogenous regarding gender. In the laparoscopy group, 2 women had hernia while in the McBurney group 4 women (2.9%) and 5 men (3.7%) suffered from hernia (Table 1).

The average age of patients in the laparoscopy and McBurney groups was $30.3 \pm 9.8$ years and $35.3 \pm 12.3$ years, respectively (P<0.001) (Table 2). 30 patients (23.4%) who were operated using the laparoscopy method were smokers while 35 patients (25.7%) in the McBurney group were smokers (P=0.67). In the laparoscopy group 2 (1.6%) non-smokers had hernia while in the McBurney group 7 (5.1%) non-smokers and 2 (1.5%) smokers had hernia (Table 3).

26 patients (20.3%) who were operated through laparoscopy had a history of appendicitis while in the group operated using the McBurney group 26 patients (19.1%) had a history of appendicitis (P=0.87).

In the laparoscopy group, 2 patients (1.6%) with a history of appendicitis were diagnosed with hernia while in the McBurney group, hernia was observed in 2 patients (1.5%) with a history of appendicitis and 7 patients (5.1%) without a history of appendicitis (Table 4).

18 patients (14.1%) that were operated using laparoscopy had a history of constipation and 21 patients (15.4%) operated using the McBurney method had also a history of constipation (P=0.86). In the laparoscopy group, 2 patients (1.5%) with a history of constipation were diagnosed with hernia, while in the McBurney group 2 patients (9.5%) with a history of constipation and 7 patients (6.1%) with no history of constipation were diagnosed with hernia.

Moreover, 12 patients (9.4%) who were operated using the laparoscopic method had a history of infection while 25 patients in the McBurney group (18.4%) had a history of infection (P=0.49).

In the laparoscopy, 2 patients (1.6%) with a history of infection had hernia while in the McBurney group 4 patients (2.9%0 with a history of infection and 5 patients (3.7%) without a history of infection were diagnosed with hernia (Table 5).

Concerning the type of appendicitis in the laparoscopy group it could be said that 104 patients (81.2%) had purulent appendix and 24 patients (18.8%) had Phlegmon appendix. In the McBurney group, 83 patients (61%) had purulent appendicitis, 12 (8.8%) had abscesses, 26 (19.1%) had Phlegmon appendicitis, and 15 (11%) had perforated appendix (P<0.001).

In the laparoscopy group, 2 patients (8.3%) with Phlegmon appendix had hernia, while in the McBurney group 3 patients (2.2%) with purulent appendix, 1 patient (0.7%) with abscess, 2 patients (1.5%) with Phlegmon appendix and 3 patients (2.2%) with perforated appendix had hernia (Table 6). According to the results, the relationship of incidence of hernia with smoking and age is significant. In addition, the chance of incidence of hernia in smokers is almost

10.9 times the chance of nonsmokers (P=0.016).

For each unit of increase in age, the chance of development of hernia increases by 10% (P=0.007). Other variables are not significantly related to hernia (P>0.05). For instance, results concerning the type of surgery suggest that the chance of development of hernia in patients who undergo surgery using the McBurney method is 3.32 times those who undergo laparoscopy (P=0.23). Concerning appendix, it shall be said that the chance of development hernia in patients with Phlegmon appendix is almost 3.2 times the patients with purulent appendix (P=0.21). The chances are also 32% higher in perforated appendix than purulent appendix. However, the difference is not statistical significant with P>0.05.

**Table.1** Frequency of inguinal hernia based on Gender

| Group | Gender | Whit Inguinal Hernia | Without Inguinal Hernia | Total |
|---|---|---|---|---|
| Laparoscopic Group | Male | 0(0%) | 56(43.8%) | 56(43.8%) |
| | Female | 2(1.6%) | 70(54.7%) | 72(56.2%) |
| McBurney Group | Male | 4(2.9%) | 42(30.9%) | 46(33.8%) |
| | Female | 5(3.7%) | 85(62.5%) | 90(66.2%) |

**Table.2** Comparison of patient's age between two groups

| Group | Count | Mean±Std | P |
|---|---|---|---|
| Laparoscopic Group | 128 | 30.3±9.8 | <0.001 |
| McBurney Group | 136 | 35.3±12.3 | |

**Table.3** Frequency of inguinal hernia based on Smoking

| Group | Smoking | Whit Inguinal Hernia | Without Inguinal Hernia | Total |
|---|---|---|---|---|
| Laparoscopic Group | Positive | 2(1.6%) | 96(75%) | 98(76.6%) |
| | Negative | 0(0%) | 30(23.4%) | 30(23.4%) |
| McBurney Group | Positive | 2(1.5%) | 99(72.8%) | 101(74.3%) |
| | Negative | 7(5.1%) | 28(20.6%) | 35(25.7%) |

**Table.4** Frequency of inguinal hernia based on History of Appendicitis

| Group | History of Appendicitis | Whit Inguinal Hernia | Without Inguinal Hernia | Total |
|---|---|---|---|---|
| Laparoscopic Group | Positive | 0(0%) | 102(43.8%) | 102(43.8%) |
| | Negative | 2(1.6%) | 24(54.7%) | 24(54.7%) |
| McBurney Group | Positive | 7(5.1%) | 103(30.9%) | 103(30.9%) |
| | Negative | 2(1.5%) | 24(62.5%) | 24(62.5%) |

**Table.5** Frequency of inguinal hernia based on History of Infection

| Group | History of Infection | Whit Inguinal Hernia | Without Inguinal Hernia | Total |
|---|---|---|---|---|
| Laparoscopic Group | Positive | 2(1.6%) | 114(89.1%) | 116(90.6%) |
| | Negative | 0(0%) | 12(9.4%) | 12(9.4%) |
| McBurney Group | Positive | 5(3.7%) | 106(77.9%) | 111(81.6%) |
| | Negative | 4(2.9%) | 21(15.4%) | 25(18.4%) |

**Table.6** Frequency of inguinal hernia based on Appendicitis Types

| | Type Appendicitis | Whit Inguinal Hernia | Without Inguinal Hernia | Total |
|---|---|---|---|---|
| Laparoscopic Group | Purulent | 0(0%) | 104(81.2%) | 104(81.2%) |
| | Abscess | 0(0%) | 0(0%) | 0(0%) |
| | Phlegmon | 2(8.3%) | 22(17.2%) | 24(18.8%) |
| | Perforated | 0(0%) | 0(0%) | 0(0%) |
| McBurney Group | Purulent | 3(2.2%) | 80(58.8%) | 83(61%) |
| | Abscess | 1(0.7%) | 11(8.1%) | 12(8.8%) |
| | Phlegmon | 2(1.5%) | 24(17.6%) | 26(19.1%) |
| | Perforated | 3(2.2%) | 12(8.8%) | 15(11%) |

The chance of development of hernia in patients with a history of infection is almost 2.5 times patients with no history of hernia (P=0.24). The same interpretations also apply to other variables. Finally, the Hosmer & Lemeshow statistic indicates that this model has a good fit for data (P=0.98).

Acute appendicitis is the main cause of acute abdomen surgery such that 7% of people need appendectomy during the lifetime due to the development of acute appendicitis (20).

The highest incidence of this disease is associated with the second and third decades of life, while its prevalence is slightly higher among men than women (21). The ratio of development in the male to female genders is 3.1 to 1 while the age range varies from 1 to 89 years (21-22).

In this research, the average age of patients in the laparoscopy and McBurney groups was $30.3 \pm 9.8$ and $35.3 \pm 12.3$ years, respectively. Therefore, the results of this study are similar to other studies regarding the age of development of appendicitis. In this research, 162 patients (61.4%) were male and 102 (38.6%) were female. This also proves the higher chance of development of appendicitis in men.

According to many researchers, Laparoscopic Appendectomy is an effective reliable method for the treatment of acute appendicitis (23-24). In many specialized centers of the world, laparoscopy is used to treat patients with acute appendicitis (25).

The largest meta-analysis that compared the Open Appendectomy and laparoscopic methods included 47 studies, out of which 39 were conducted on adults. The analyses proved that the cost of surgery and duration of surgery are higher in Laparoscopic Appendectomy than open surgery, but the prevalence of wound infection after

laparoscopy is almost half the open surgical method (26).

However, the chance of abdominal abscesses following Laparoscopic Appendectomy is three times Open Appendectomy. In another research, which covered 1960 patients, 1035 patients were exposed to Laparoscopic Appendectomy and 925 were exposed to Open Appendectomy. It was found that Laparoscopic Appendectomy was accompanied with a lower level (%) of wound infection as compared to Open Appendectomy (9.2% vs. 4.7%).

In this research, 12 patients (9.4%) who were operated using the laparoscopy method had a history of infection, but the number of patients with history of infection in the McBurney group was 25 (18.4%), which indicated the low level of infection in the laparoscopy group.
Today, laparoscopy is known as an advanced reliable operation method in general surgical wards. In some training hospitals, all of the patients suffering from the right iliac fossa pain undergo laparoscopy prior to appendectomy. Although Laparoscopic Appendectomy is somewhat commonly used, it requires more work than laparoscopic cholecystectomy. Some surgeons believe that Laparoscopic Appendectomy should be used as the major treatment for appendicitis, while another group of surgeons do not believe so. Therefore, Laparoscopic Appendectomy is still considered a debatable issue (28-33).

Inguinal hernia is a common disease and accounts for 75% of all hernias. The prevalence of inguinal hernia in men is estimated to be 25 times more than women and about 10% of outpatients visiting general surgeons suffer from inguinal hernia (34).

According to the existing resources, the prevalence of incisional hernia following open appendectomy is 0.7-0.12%. With the advancement of laparoscopy the number of transformational operations may decline and this decrease may lead to a reduction in the number of incisional hernias. Incisional hernia after appendectomy is not common and is observed in less than 0.12% of patients. Interstitial incisional hernia following appendectomy is also extremely rare (35-39).

In spite of the development of surgical techniques, operation devices and materials, surgical wound hernia is still an important problem in the case of abdominal operations (40).

According to the reported studies, the rate of incisional hernia at the site of surgery following abdominal surgery is about 10% (41). Abdominal wall defect occurs during the first 5 years following a surgical incision, but it sometimes occurs later on (42).

Two types of hernia may occur following to surgeries. In the common type of hernia, hernia extends to all of the layers of the abdominal all. The less prevalent hernia is interstitial hernia in which hernia extends to the defect between the abdominal transverse muscle and the internal oblique muscle, but the external oblique muscle aponeurose is not involved (43). This type of hernia may be easily overlooked and in suspected patients it is necessary to confirm the diagnosis through screening performed using ultrasound or CT-Scan methods (44). The prevalence of this disease depends on factors such as age, gender, obesity, smoking, diabetes, use of steroids, and a number of surgical factors (including emergency surgeries, intestinal surgery, stitching method, surgical method, breast

infarction, abdominal distension, wound infection, placement of drains inside incisions, and firmly connecting stitches to the internal oblique and transverse muscles of the abdomen which causes muscle necrosis) (43-46).

According to the results obtained in this research, development of hernia is significantly related to smoking and age. Moreover, the chance of development of hernia in smokers is almost 10.9 times non-smokers, and the result was statistically significant (P=0.016).

For each unit of increase in age, the chance of development if hernia increases by 10%, and the increase was statistically significant (P=0.007). There was no significant relationship between other variables and development of hernia (P<0.05).
In a case report study by Sqn Ldr A Kumarj et al., a 32 year old man who was suffering from pain and inflammation on the right and bottom sides of his abdomen from three years before, the history of appendectomy surgery for the treatment of perforated appendicitis three years before was mentioned as the cause. At the time of surgery, the surgery site developed infection and was treated conservatively. In the ultrasound examination of the patient, intestinal sac was observed immediately below the surgery scar. Following appendectomy, the patient was diagnosed with incisional interstitial hernia and was listed on the list of surgeries (47).

Mahmoud Hamouda et al. also conducted a case report study in which they examined an 18 year old man who complained about sudden colicky abdominal pain and vomiting. The patient did not have fever and had a soft abdomen with generalized tenderness. The rectum showed to be empty in the digital rectal exam. The patient had a history of recent appendectomy due to perforated appendicitis. The appendectomy had been carried out seven days before. The CT-Scan of the patient revealed a 3-cm muscle defect and the hernia sac had extended into the external oblique muscle. The patient was diagnosed with post-appendectomy inguinal hernia and he was subjected to abdominal re-exploration (48).
In the research by Marcelo, 4862 files of patients over 15 years of age and a history of acute appendicitis surgery were studied. Of the patients under study, 4523 (93%) had been subjected to McBurney incision while 34 patients (0.7%) developed incisional hernia. Three patients also experienced recurrence of the disease. Finally, the risk of development of hernia following McBurney incision was reported to be very low for acute appendicitis (49).
In this study, only one case of incisional hernia following McBurney incision was reported (0.7%). This result complies with the findings of Psy.

Concerning the type of surgery it can be said that the chance of development of hernia in patients who were operated using the McBurney method was 3.32 times patients operated using the laparoscopic method, but the increase was not statistically significant (P=0.23). At the end of the research it was found that there is no relationship between type of surgery and incidence of inguinal hernia. However, the prevalence of inguinal hernia in the group undergoing open surgery was higher. Further prospective studies (covering the time surgery to the incidence of hernia) are recommended. These studies shall consider all of the risk factors in a longer study period.

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