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Original Research

Comparison of Incisional Hernias with Another Type of Abdominal Hernias in Terms of Predisposing Factors

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ABSTRACT

Objective: Incisional hernia (IH) is a common late complication of abdominal surgery. Factors such as wound infection, type of incision, wound closure technique, and suture material used and patient-related factors such as age, gender, body mass index (BMI), diabetes mellitus (DM), and smoking are also involved in the development of IH and other types of abdominal hernias (OTAH). In this article, we compared the predisposing factors for IH and OTAH in light of the literature.

Methods: Among 130 patients operated for abdominal hernia between January 2015 and December 2018 at the Department of General Surgery of GÜLHANE Training and Research Hospital, we analyzed the predisposing factors for IH and OTAH.

Results: The female-to-male ratio was 28:102, mean age was 58.6 years, and mean BMI was 29.3 kg. The prevalence of DM and smoking was also evaluated. The rate of drain application and hospitalization duration was 56.2% to 4.1% and 8.6–5.3 days in IH and OTAH groups, respectively.

Conclusion: We determined that male gender is a dominant risk factor for OTAH and high BMI for IH. Age, DM, and smoking are equivalent risk factors for both. Drain application for IH is highly statistically significant, which results in prolonged hospitalization. These results suggest an important complication of DM and obesity and conclude that obesity is a major risk factor for IH.

Keywords: Abdominal hernia, diabetes mellitus, herniorrhaphy, incisional hernia, obesity

INTRODUCTION

Incisional hernia (IH) is a type of abdominal hernia that occurs at the previous surgical incision site. The incidence of IH at midline incisions is higher than the incisions in other regions. Despite advances in abdominal wall closure techniques, the rate of development of IH after laparotomy ranges from 15% to 20% (1). More than 50% of IHs originating from abdominal incisions occur within the first year after surgery and 80% within the 3 years (2, 3). Other types of abdominal hernias (OTAH) are the hernias that do not originate from previous abdominal incisions but from the anatomically weak sites of the abdominal wall. The abdominal hernia of a patient independent from being IH or OTAH has the risk of strangulation and may cause other life-threatening complications if it is huge in size and irreducible and consists of abdominal luminal organs. Particularly in such cases, surgical treatments for hernias are strongly recommended.

Factors such as wound infection, location or type of incision, wound closure technique, and suture material and patient-related factors such as age, body mass index (BMI), presence of diabetes mellitus (DM), and smoking are considered other important risk factors for developing IH. In addition, poor nutritional status, chronic lung disease, renal failure, malignancies, and steroid therapies are also considered facilitating factors for developing IH (1, 4).

In this study, we examined the data of 130 patients with abdominal hernia operated between January 2015 and December 2018 at the Department of General Surgery of Gülhane Training and Research Hospital, University of Medical Sciences. Among 130 patients, 32 patients had IH and 98 patients had OTAH. The data of the 2 groups were also compared statistically. This study aimed to determine the factors for developing abdominal hernias and whether the factors have the same impact on both IH and OTAH. In addition, we compared the herniorrhaphy techniques, drain application, and hospitalization durations of the patients.

METHODS

The data of 130 abdominal hernia patients operated in General Surgery Department of Gülhane Training and Research Hospital, University of Medical Sciences, between January 2015 and December 2018 were retrospectively analyzed. The analyzed data of the patients were age, gender, BMI, DM smoking, hernia repair technique, hospitalization duration, and drain applications. Notably, 32 operated 32 had IH and 98 had OTAH. Because this study was a retrospective analysis of patient medical data without collecting any personal data, no informed consent was obtained from the patients. As authors of the manuscript, we declare that all procedures followed in this study were in accordance with the ethical standards of the responsible committee on human exper-

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Table 1. Sociodemographic and clinical features of patients with incisional hernia and other types of abdominal hernias

	IH (n = 32)		OTAH (n = 98)		Total (n = 130)		
Gender	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**P**
	19 (41%)	13 (59%)	83 (84%)	15 (16%)	102 (78%)	28 (22%)	0.02
Age distribution (mean)	24–75 (56.8±5.7) years		21–86 (59.2±8.1) years		21–86 (58.6±7.5) years		0.26
BMI distribution (mean)	18.8–39.8 (29.3±3.4)		19.5–40.1 (27.2±3.6)		18.8–40.1 (27.8±4.1)		0.03
DM	Yes	No	Yes	No	Yes	No	
	6 (18.7%)	26 (83.3%)	14 (14.3%)	84 (85.7%)	20	110	0.57
Smoking	Yes	No	Yes	No	Yes	No	
	14 (44.6%)	18 (55.4%)	47 (47.9%)	51 (52.1%)	61	69	0.67
Drain application	Yes	No	Yes	No	Yes	No	
	18 (56.2%)	14 (43.8%)	4 (4.1%)	94 (95.9%)	22	108	<0.00
Duration of hospital stay (mean)	2–19 (8.6±3.2) days		1–18 (5.3±4.1) days		1–19 (7.2±4.0) days		<0.00

IH: incisional hernia, OTAH: Other types of abdominal hernia, BMI: Body mass index, DM: Diabetes Mellitus

imentation (institutional and national) and with the Declaration of Helsinki of 1964 and its later amendments.

Statistical Analysis

Gender, age, BMI, DM, smoking, postoperative drain application, and hospitalization duration of the 2 groups were evaluated using SPSS version 16.0 (SPSS Inc.; Chicago, IL, USA) for statistically significant differences. $p<0.05$ was considered statistically significant. Nonparametric test chi-square was used for gender, DM, smoking, and postoperative drain application, whereas Mann–Whitney U test was used for age, BMI, and hospitalization duration. Age, BMI, and hospitalization duration parameters were also evaluated for descriptive statistics. Gender, DM, smoking, and postoperative drain application parameters were evaluated for percentage distribution.

A statistically significant difference of 3 operation techniques used for the 2 groups were evaluated using SPSS version 16.0. Percentage distribution for 3 operation techniques was evaluated, and nonparametric chi-square test was used for statistical analysis. $p<0.05$ was considered statistically significant.

RESULTS

The majority of all patients with abdominal hernia were male. The female-to-male ratio was 13:19 in the IH group and 15:83 in the OTAH group with a total of 102 male and 28 female patients (Table 1). Males are found to be highly statistically significant in the OTAH group. The ages of the patients ranged from 24 to 86 years (58.6 ± 7.5) (Table 1). No statistically significant difference was found in mean age between the groups.

Patients were evaluated for BMI, DM, and smoking. The mean BMI was 29.3 ± 3.4 kg/m^2 in patients with IH and 27.2 ± 3.6 kg/m^2 in patients with OTAH (Table 1). Statistically significant difference was found between the 2 groups. The presence of DM in patients between the 2 groups was compared; 6 (18.3%) of the patients in the IH group and 14 (14.3%) patients in the OTAH group had DM, which showed no statistically significant difference between the 2 groups (Table 1). One patient in each group was treated with insulin and the others were with oral antidiabetic agents. The prevalence of smoking was found to be 44.8% in the IH group and 47% in the OTAH group (Table 1) with no statistically significant difference between the groups.

Regardless of the type of repair technique, the rate of drain application was 56.2% in the IH group and 4.1% in the OTAH group (Table 1), which showed a statistically significant difference between the 2 groups.

The duration of hospital stay ranged from 1 to 19 days, with a mean duration of 8.6 ± 3.2 days in the IH group and 5.3 ± 4.1 days in the OTAH group, showing that hospitalization of IH patients is statistically longer than OTAH patients (Table 1).

Patients were evaluated in 3 subgroups in terms of hernia repair technique: classical herniorrhaphy using primary suturing, herniorrhaphy using mesh repair, and fence-darning technique (Table 2). The rate of classical herniorrhaphy using primary suturing, herniorrhaphy using mesh repair, and fence-darning technique in the IH and OTAH groups were 12.5%, 28.1%, and 59.4% and 13.2%, 61.2%, and 25.5% respectively (Table 2).

Main Points:

- The male gender is the dominant risk factor for OTAH and obesity is dominant for IH.
- Drain application for IH is highly statistically significant for delayed hospitalization.
- Newly defined complication of DM and obesity is abdominal hernia in which obesity has more effect on developing IH.

Table 2. Distribution of hernia repair types

	IH (n = 32)	OTAH (n = 98)	Total (n = 130)	p
Primary repair	4 (12.5%)	13 (13.2%)	17 (13.1%)	<0.01
Mesh herniorrhaphy	9 (28.1%)	60 (61.2%)	69 (53.1%)	
Fence darning	19 (59.4%)	25 (25.5%)	44 (33.8%)	

IH: Incisional hernia, OTAH: Other types of abdominal hernia

DISCUSSION

Age and gender are both believed to be the risk factors for abdominal hernias. Older age affects wound-healing impairment as DM, which will be discussed later on, and causes IH. In addition, as patients get older, the strength of connective tissues decreases, which causes weakening of the abdominal anterior wall and OTAH. Therefore, there is no doubt that age is a predisposing factor for abdominal hernia. However, in our study, no statistical difference was found in age between the 2 groups. We conclude that age is an equivalent risk factor for both IH and OTAH.

Gender is also known as a risk factor for abdominal hernia; however, its effect on OTAH and IH is unknown. We compared its predisposing effect in each group separately. We found that male gender is more of a risk factor for OTAH than IH. This may be a result of males dealing with more muscle works and more increased intraabdominal pressure. As they get operated, they decrease their muscle works owing to the advice of the care provider; hence, male gender is not considered a dominant predisposing factor for IH.

Obesity is an important risk factor for developing IHs after abdominal surgery and may cause problems with wound healing in a significant proportion of patients with a BMI of >30 kg/m^2 in the early or late postoperative period (2, 5, 6). Wound complications, such as wound infections and wound separation, are frequently associated with obesity because of poor vascularization of increased adipose tissue and proliferation of proinflammatory tissue factors. Obesity increases the rate of IH by impairing wound healing or causing infections. In addition, the increase in the risk of developing IH should be noted because of the increased intraabdominal pressure in obesity. In many animal experiments, physical and pathological events that increase intraabdominal pressure cause herniation of the abdominal wall in weak areas or sutured incision sites. The weak areas of the abdominal wall are not only the incisional scars but also the physiological and anatomical locations such as umbilicus and the inguinal region. Therefore, obesity is also considered a risk factor for OTAH (7). However, our study resulted that obesity is a more dominant risk factor for IH.

It is very difficult to conduct human experimental studies on intraabdominal pressure and tissue resistance. Because of their different anatomical structures, the results of animal studies are not fully scientifically valid for humans. Therefore, Kroese et al. created a simulator called AbdoMAN and conducted different studies on this model, which has very similar features to the muscles and fascia of the human abdominal wall. Furthermore, they clearly demonstrated the importance of increased intraabdominal pressure for developing IH (8, 9). These studies have reported that factors that increase intraabdominal pressure, such as coughing, straining, vomiting, obesity, and heavy physical exercise, may increase the risk of IH independent of other factors. Therefore, patients should be investigated in the postoperative period for constipation, pulmonary infection, or difficulty in urination, and if necessary, medical treatment should be initiated for the diseases causing these symptoms.

In our study, the IH and OTAH groups were evaluated for obesity by measuring the BMI of the patients. We found out that the BMIs of the 2 groups were statistically different, which supports the data in the literature that obesity can cause both the IH and OTAH and is a more dominant risk factor for IH. From this result, it can also be stated that the incisional scars are weaker than the anatomical weak areas of the abdominal wall. In conclusion, we believe that obesity is a risk factor for both IH and OTAH, and patients with high BMI should be advised to lose weight to reduce the risk of IH.

DM is one of the known risk factors for developing IH and is responsible for many possible local and systemic complications (10, 11). DM causes these adverse effects by disrupting the vascular structures, resulting in tissue ischemia, or by further compromising the general condition of the patients owing to previously developed systemic complications related to cardiac or nephrological system. DM, which causes delay in wound healing and increases wound complications, also demonstrates these effects by impairing collagen synthesis. Similar to DM, smoking also has a negative impact on wound healing through the mechanism of collagen synthesis and is therefore seen as a risk factor for developing IH. Studies have indicated that approximately 8% of patients with abdominal hernias had DM and 43% had smoking. Our results showed that the frequency of DM was slightly higher, but the remaining results were consistent with data from the literature (9, 12-15). However, we could not find statistically significant difference between the IH and OTAH groups for DM and smoking. Because DM and smoking are associated with wound-healing impairment and weakening of normal tissues, we determined that they have an equal effect on both IH and OTAH. This may be a result of not only affecting the wound healing but also weakening the abdominal wall by the pathophysiology described earlier.

Studies on the role of obesity, DM, smoking, and related collagen synthesis disorders in the etiology of IH have yielded conflicting results. The connective tissue consists of 3 groups of extracellular proteins, namely, proteoglycans, glycoproteins, and collagens. Proteoglycans regulate the structure and permeability of tissues, whereas glycoproteins are proteins that are effective in cell-to-cell interactions. Connective tissue dysfunctions are associated with collagen synthesis disorders because collagen is responsible for matrix structure and connective tissue support (16). In fact, some experimental studies have found that the most intense changes in collagen metabolism occur directly in the anterior sheath of the abdominal rectus muscle. However, despite

these proven functional properties of collagen structures, many clinical observational studies reported no statistically significant difference between the hernia types in terms of age, DM, and smoking (9, 17). A published systematic analysis analyzed 55 original articles evaluating connective tissue changes in patients with abdominal hernias and reported no statistically significant difference in collagen changes between IH and OTAHs (18). These studies support the results of our study that there is no statistically significant difference between IH and OTAH in terms of DM and smoking.

Apart from DM and smoking, wound infection, location, type of incision, wound closure material, and wound closure technique are other important factors involved in the etiology of IH. The development of wound infection releases many mediators in the surgical area, disrupts the general resistance of the patient, delays the formation of granulation tissue in the wound area, and prevents wound healing by disrupting the collagen synthesis. It has been shown that collagen synthesis has been reduced especially after contaminated surgical procedures and in patients with infected wounds, and this result is defined as a risk factor for developing IH. One study reported that IH developed in the first year after surgery in 21% of patients who underwent colorectal surgery (6). The published series reported that half of patients with IH had a history of wound infection in the postoperative period and reported that the risk of developing IH in the first postoperative year was 5-fold higher in patients with wound infection than in those without wound infection (4, 8). In our study, we had no wound infections after surgery and cannot conclude for the effect of would infection on IH and OTAH. In addition, we did not evaluate our patients for the location of the incision, type of incision, and wound closure material. However, we found a statistically significant difference among the wound closure techniques used for the repair of IH and OTAH.

The closure technique and materials for abdominal incisions are thought to affect the development of IH (19, 20). Although there are still discussions on the wound closure technique and the materials used in surgery, it is considered sufficient to use any nonallergic material that does not increase the risk of infection and can provide adequate tissue resistance. Abdominal closure is underestimated by most surgeons and is generally considered an educational activity for inexperienced residents. The closure of laparotomy should be taken as seriously as all previous operative procedures and handled with appropriate techniques and materials (9). One of the key points in preventing the development of IH is the use of fascia sutures, which can last for a long time and can resist tissue resistance. In patients undergoing laparotomy, only 70% of the tensile strength of fascia can be recovered 1 year after fascia repair. Therefore, suture materials that are absorbed and lose their strength in a short time are not suitable for fascia repair. Although studies have indicated that wound-stretching force is higher in the single suture technique than the continuous suture technique for laparotomy closure, single or continuous or monofilament/polypropylene sutures could not be found to have a significant effect on wound healing and the development of IH. Some authors argue that the use of continuous suture technique increases the risk of IH based on studies indicating that this suture technique causes insufficient wound tensile strength (21, 22).

The literature data given earlier obviously state that the closure technique is a factor for abdominal hernias, and we compared the wound closure techniques in both groups. Even though we did not evaluate the relapse rates after the wound closure techniques, we found that the primary saturation technique is applied with the same ratio for the IH and OTAH. However, the fence-darning technique is used more in IH and mesh herniorrhaphy in OTAH. This may be a result of habits for inguinal herniorrhaphy, which is the Lichtenstein technique. Because the Lichtenstein technique is a gold standard for inguinal hernia repair, which is evaluated in the OTAH group, the rate of mesh herniorrhaphies is higher in the OTAH group than the IH group. However, fence darning is safer because a prosthetic material is not applied, resulting in a lower risk of wound infection. This may result in surgeons choosing a fence-darning technique in reoperated wounds as IH.

In patients undergoing mesh repair, some precautions should be taken, such as the use of drains and antibiotic agents to avoid the risk of seroma, hematoma, and mesh reactions. Thus, we compared the drain application in both groups. We found out that there is statistically significant difference between the IH and OTAH groups, in which drain application is higher in the IH group. However, mesh herniorrhaphy is higher in the OTAH group, which is just the reverse of drain application indication for the presence of mesh. This may be because the only indication for drain application is not the presence of mesh. It is also applied for the risk of hemorrhage. Reoperated IHs has more risk of bleeding. This may cause surgeons to apply the drain to incisional IH.

Hospitalization duration is related to the expected postoperative complications and patient postoperative recovery. In our study, we found that hospitalization of IH patients is longer than of OTAH patients, which may be owing to IH being more complicated than OTAH. In addition, we found that the rate of drain application is higher in the IH group than the OTAH group, which may also cause the longer hospitalization of the patients for drain monitoring. However, because no bleeding and wound infection are found in both groups, the unnecessary application of drain owing to the surgeon's obsessions should be accepted (23).

CONCLUSION

Many factors described earlier predispose patients to develop abdominal hernias, but the significance of these factors for IH and OTAH are not much debated. In this study, we specified the significance of the predisposing factors according to the type of abdominal hernia classified as IH and OTAH. We determined that the male gender is the dominant risk factor for OTAH and obesity is dominant for IH, whereas age, DM, and smoking are the equivalent risk factors for both IH and OTAH. We also found out that drain application for IH is highly statistically significant in IH, which results in delayed hospitalization. All these results state that age, DM, and smoking are risk factors not only for IH but also for OTAH. In addition, these results show another complication

of DM and obesity, which is abdominal hernia. Therefore, physicians have one more reason to cure obesity and DM aggressively. In addition, we found out that obesity has more effect on developing IH; hence, we believe that surgeons should recommend patients to lose weight after surgery if the patient has a high BMI to prevent IHs.

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