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Changes in the Frequencies of Abdominal Wall Hernias and the Preferences for Their Repair: A Multicenter National Study From Turkey

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Abdominal wall hernias are a common problem in the general population. A Western estimate reveals that the lifetime risk of developing a hernia is about 2%.[1–3] As a result, hernia repairs likely comprise the most frequent general surgery operations. More than 20 million hernias are estimated to be repaired every year around the world.[4] Numerous repair techniques have been described to date however tension-free mesh repairs are widely used today because of their low hernia recurrence rates. Nevertheless, there are some ongoing debates regarding the ideal approach (open or laparoscopic),[5,6] the ideal anesthesia (general, local, or regional),[7,8] and the ideal mesh (standard polypropylene or newer meshes).[9,10]

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Although laparoscopic procedures have gained popularity worldwide, laparoscopic repairs still constitute only a small fraction of hernia surgeries,[11–13] mainly due to costs and the need for expertise. Today, general anesthesia is still the most frequently-used anesthesia technique. The usage of local anesthesia has been increasing, however, although its routine use is limited to specific hernia centers.[14–16] On the other hand, standard heavyweight propylene meshes lead the market mostly because of their low cost. Newer lightweight meshes should be considered as a first alternative to heavyweight conventional polypropylene meshes, provided that adequate fixation is guaranteed.

The most frequent hernia type is inguinal. According to some classical reference books, the frequency of abdominal wall hernias is as follows: inguinal (70%–75%), femoral (6%–17%), and umbilical (3%–8.5%), followed by rare forms (1%–2%).[1,2] No changes in the frequencies of different types of abdominal wall hernias have been published in 3 consecutive editions of a well-known surgical textbook between 2004 and 2012.[17–19] However, a recent UK study found that the frequencies of different types of abdominal wall hernias change with time and that the figures given in the classical books should be subject to scrutiny.[3]

In our observations over recent years, there have been some changes not only in the frequencies but also in the repair preferences and anesthetic techniques in daily surgical practice. Therefore, we aim to carry out a multicenter study to reflect the actual frequencies of abdominal wall hernias and the technical preferences for repairing these hernias in Turkey, a country with a population of over 70 million.

Materials and Methods

This multicenter study was designed and conducted by a large-volume reference hospital in Ankara, the capital city of the Republic of Turkey. In total, 20 institutions (13 university hospitals (UHs) and 7 teaching hospitals of the Ministry of Health (MH)) from 9 cities in 5 out of the 7 regions of the country were repeatedly invited to participate. Four institutions did not reply to the invitation at all. An additional 5 hospitals could not join the study because of different limitations such as insufficient data recording and a lack of personnel to compile the data. Eventually, 11 centers (6 UHs and 5 MHs) participated in the study. Two calendar-year periods were chosen, separated by an interval of 5 years: 2005 and 2010.

A study protocol draft was prepared by the conducting center and shared with all participating institutions to create a final form. The following data related to patients and repairs were retroactively obtained from patient files and operating theater registers and recorded in the study: age, sex, type of hernia, history of hernia (primary versus recurrent), acute versus elective surgery, type of anesthesia administered, operative approach (open versus laparoscopic), and the type of mesh used in the repair. Then, the parameters from 2005 and 2010 were analyzed to compare the 2 periods. Only adult patients over the age of 18 were included. The recorded hernia types were classified as inguinal, femoral, umbilical, epigastric, incisional, and other types (all other and rare types of abdominal wall hernias such as Spigelian, lumbar, etc.). The type of anesthesia was classified as general, regional, or local. The mesh types used in hernia treatments were classified as standard polypropylene mesh and others (partially absorbable lightweight mesh, polyester mesh, dual mesh, biologic mesh, etc.).

Statistical Analysis

The data were compiled and analyzed using SPSS 15.0 for Windows. Percent and mean (± standard

Table 1 General comparison of the years 2005 and 2010 regarding hernia type, repair type, anesthesia and other parameters in the study

	2005 (%)	2010 (%)	Total (%)	*P*
Hernia type (n = 2224 for 2005, n = 3139 for 2010)				
Inguinal	74.4 (72.6–76.2)	66.5 (64.8–68.1)	69.8	<0.001
Femoral	2.9 (2.2–3.6)	2.6 (2–3.1)	2.7	
Umbilical	10.5 (9.2–11.7)	13.9 (12.7–15.1)	12.5	
Epigastric	1.5 (1–2)	1.4 (1–1.8)	1.5	
Incisional	10.1 (8.8–11.3)	15.0 (13.8–16.3)	13.0	
Others	0.7 (0.4–1.1)	0.6 (0.3–0.8)	0.6	
Gender (n = 2163 for 2005, n = 2289 for 2010)				
Male	76.9 (75.2–78.7)	70.2 (68.3–72)	73.5	<0.001
Female	23.1 (21.3–24.8)	29.8 (28–31.7)	26.5	
History (n = 2165 for 2005, n = 2289 for 2010)				
Primary	91.2 (90–92.4)	89.6 (88.3–90.8)	90.4	0.06
Recurrent	8.8 (7.6–10)	10.4 (9.2–11.7)	9.6	
Setting (n = 2165 for 2005, n = 2289 for 2010)				
Elective	94.9 (93.9–95.8)	92.6 (91.5–93.6)	93.7	0.002
Emergency	5.1 (4.2–-6.1)	7.4 (6.4–8.5)	6.3	
Repair type (n = 2165 for 2005, n = 2289 for 2010)				
Prosthetic	88.4 (87–89.7)	86.8 (85.4–88.2)	87.6	ns
Tissue-Suture	11.6 (10.3–13)	13.2 (11.8–14.6)	12.4	
Repair approach (n = 2120 for 2005, n = 2210 for 2010)				
Open	97.9 (97.3–98.5)	96.5 (95.8–97.3)	97.2	0.005
Laparoscopic	2.1 (1.5–2.7)	3.5 (2.7–4.2)	2.8	
Prosthetic material (n = 1912 for 2005, n = 1989 for 2010)				
Standard polypropylene	98.2 (97.6–98.8)	95.8 (94.9–96.7)	97.0	<0.001
Others	1.8 (1.2–2.4)	4.2 (3.3–5.1)	3.0	
Anesthesia (n = 2163 for 2005, n = 2288 for 2010)				
General	76.7 (74.9–78.5)	59.9 (57.9–61.9)	68.1	<0.001
Regional	14.6 (13.1–16)	19.2 (17.6–20.8)	16.9	
Local	8.7 (7.5–9.9)	20.9 (19.3–22.6)	15.0	

Cells represent proportions (95% confidence intervals) for each year.

deviation, SD) were used as descriptive statistics for categorical and metric variables, respectively. In order to compare independent groups in terms of categorical data, a chi-squared test was used. Also, for the comparison of metric variables (*e.g.*, age) by year, one-way analysis of variance (ANOVA) was performed. $P < 0.05$ was considered statistically significant. If a statistical significance was obtained after the chi-squared test/ANOVA with more than 2 groups, pairwise comparisons were also made in order to determine which groups differ. In this process, Bonferroni correction was used to reduce the chance of obtaining false-positive results (type I errors) when multiple pairwise tests were performed on a single dataset.

Results

A total of 5363 patients were operated on in 2005 and 2010 at the 11 participating centers, creating a large case pool. Although some figures were found not to change with time, some clear changes were observed in a comparative analysis of the data. Overall, the patient volume in a calendar year seemed to be same after a 5-year interval. There was only a 6% increase in the total number of repairs in 2010, relative to 2005.

Hernia types

There were significant changes in the frequencies of hernia types operated on in 2005 and 2010. Inguinal hernia repair was the most common repair in both periods. Incisional and umbilical hernia repairs significantly increased. Overall, male patients dominated the series, however, the proportion of the female patients showed a significant rise in 2010 ($P < 0.001$; Table 1).

Age and gender

The mean (± SD) ages were 51.9 (± 15.9), 49.3 (± 16.1), 51.4 (± 14), 50.8 (± 14.5), 58.8 (± 12.8), and 54.9 (± 14.3) for inguinal, femoral, umbilical, epigastric, incisional, and other types of hernias, respectively, in 2005. In 2010, these same figures are 52.8 (± 16.3), 51.4 (± 14.4), 53.4 (± 14.2), 52.3 (± 17.2), 55.6 (± 12.6), and 56.0 (± 12.5), respectively. All of the mean figures were similar in the 2 periods.

The distribution of sex for abdominal wall hernia patients differs between 2005 and 2010 ($P < 0.01$). The vast majority of the operations were on men for inguinal hernia repairs in both periods. Neverthe-

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Table 2 Crosstabulation of repaired hernias types and gender by two time periods (2005 and 2010) ($P < 0.001$)

	2005		2010	
	Male (%)	Female (%)	Male (%)	Female (%)
Inguinal				
proportion of a gender within repairs of this type of hernia in the year*	90.7 (89.3–92.1)	9.3 (7.9–10.7)	87.7 (86–89.3)	12.3 (10.7–14)
proportion of specific hernia type within each gender in the year**	88.7 (87.2–90.2)	30.5 (26.4–34.5)	80.0 (78.1–82)	26.5 (23.2–29.8)
Femoral				
proportion of a gender within repairs of this type of hernia in the year*	49.2 (36.6–61.7)	50.8 (38.3–63.4)	50.0 (35.9–64.1)	50.0 (35.9–64.1)
proportion of specific hernia type within each gender in the year**	1.8 (1.2–2.4)	6.2 (4.1–8.3)	1.5 (0.9–2.1)	3.5 (2.1–4.9)
Umbilical				
proportion of a gender within repairs of this type of hernia in the year*	35.9 (29.6–42.2)	64.1 (57.8–70.4)	39.4 (34.1–44.7)	60.6 (55.3–65.9)
proportion of specific hernia type within each gender in the year**	4.7 (3.7–5.8)	28.3 (24.3–32.2)	8.1 (6.8–9.4)	29.3 (25.9–32.7)
Epigastric				
proportion of a gender within repairs of this type of hernia in the year*	57.6 (40.7–74.4)	42.4 (25.6–59.3)	60.0 (40.8–79.2)	40.0 (20.8–59.2)
proportion of specific hernia type within each gender in the year**	1.1 (0.6–1.7)	2.8 (1.4–4.3)	0.9 (0.5–1.4)	1.5 (0.6–2.4)
Incisional				
proportion of a gender within repairs of this type of hernia in the year*	27.4 (21.3–33.5)	72.6 (66.5–78.7)	36.1 (31.4–40.8)	63.9 (59.2–68.6)
proportion of specific hernia type within each gender in the year**	3.4 (2.6–4.3)	30.3 (26.2–34.3)	9.0 (7.6–10.4)	37.6 (34–41.3)
Others				
proportion of a gender within repairs of this type of hernia in the year*	23.1 (0.2–46)	76.9 (54–99.8)	38.9 (16.4–61.4)	61.1 (38.6–83.6)
proportion of specific hernia type within each gender in the year**	0.2 (0–0.4)	2.0 (0.8–3.2)	0.4 (0.1–0.8)	1.6 (0.7–2.6)

*: "The proportion of a gender within repairs of this type of hernia in the year" gives the **row percentages**.

: "The proportion of specific hernia type within each gender in the year" gives the **column percentages.

less, females showed quite a different spectrum: inguinal, umbilical, and incisional hernias each comprised about one-third of operations on women in 2005, while incisional hernia repairs dominated in 2010. Gender and the type of repair comparison did not show any significant changes between the periods (Table 2).

Repair preferences

Prosthetic meshes were used in the majority of the repairs in both periods with no differences in the rates ($P = 0.116$). Meshes were used in 95% of inguinal hernia repairs, however this rate was lower in other hernia repairs; mesh was used in only 60% of umbilical hernia repairs. The use of mesh in elective umbilical hernia repairs has decreased ($P = 0.031$).

The preferred mesh type in the vast majority of prosthetic repairs in 2005 and 2010 was standard heavyweight polypropylene mesh. There was an increase in the use of other meshes (partially absorbable lightweight mesh, polyester mesh, dual mesh, biologic mesh, etc.) in incisional hernia repairs. Although the laparoscopic approach showed a significant rise overall ($P = 0.005$), 96.5% of the repairs were still done using open techniques in 2010. The rise in the laparoscopic repair rate is only obvious for inguinal hernias ($P = 0.033$).

Overall, prosthetic repair was used in 88.6% of elective and 81.3% of emergency repairs. The difference was significant ($P < 0.001$). The use of prosthetics in emergency inguinal hernia repair has increased ($P = 0.001$). Tissue-suture repairs for inguinal and femoral hernias were preferred more frequently in emergency cases than in elective settings, whereas prosthetic meshes were used more frequently in emergency umbilical and epigastric hernia repairs than elective repairs. The rate of mesh

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use in emergency repairs did not show a significant difference between 2005 and 2010.

Anesthesia

The most striking change appeared in the type of anesthesia used in hernia repairs. General anesthesia was the most preferred type, used in more than 75% of all hernia repairs in 2005. The rates of local and regional anesthesia for inguinal and femoral hernia repairs displayed significant increases in 2010 ($P < 0.001$). The use of local anesthesia showed a 240% increase.

Re-repair

Recurrent hernia repairs also displayed an increase, but the difference between the two periods stayed just below the level of significance ($P = 0.060$).

Emergency repairs

The proportion of emergency repairs in 2010 was significantly higher than that in 2005 ($P = 0.046$). 51.8% of all emergency operations were inguinal hernia repairs. Incarcerated umbilical hernias were the second most common cause for an emergency repair, representing 21.2% of all emergency repairs. The rates for incisional, femoral, and epigastric hernias were 16.3%, 8.0%, and 1.7%, respectively. On the other hand, only 5% of all inguinal repairs were done in an emergency setting, whereas this rate was 20.0%, 11.5%, 8.5%, and 7.7% for femoral, umbilical, epigastric, and incisional hernias, respectively.

Discussion

Since Edoardo Bassini introduced his excellent work in groin hernia repairs in 1889 and Shouldice Clinic reported very low recurrence rates for the same challenge using a similar technique as Bassini, 2 important developments have been observed in the repair of abdominal wall hernias.[20] The first development was tension-free repair using prosthetic materials and the second was the laparoscopic approach. There have also been some changes in the frequency of different hernia types, however. Dabbas and colleagues from the UK reported that the relative frequencies of different types of abdominal wall hernias displayed significant changes across the 1980s, 1990s, and 2000s.[3]

Groin herniorrhaphy is the most common operation performed by general surgeons. Annually, more than 20 million groin hernias are repaired worldwide.[21] In a study by Dabbas and colleagues, the frequency of inguinal hernia repair decreased over time to 64% from 80%, while the frequency of umbilical hernia repair increased to 19% from 5%.[3] On the other hand, North American data show a different picture: the frequencies of inguinal, femoral, umbilical, and incisional hernia repairs stayed unchanged in 1998 and 2003 and incisional hernia repairs showed a 2-fold increase in frequency in North America relative to the UK.[21]

Main findings

The relative frequency of inguinal hernia repairs in the present study is 66.5% in 2010. This result is well matched with data from Rutkow and Dabbas.[3,21] On the other hand, the same figure in 2005 was 74.4%, which is also consistent with the figure for the 1990s in the paper by Dabbas and colleagues. This percentage furthermore agrees with the last three editions of a well-known surgical textbook.[17–19] It is possible to state that the frequencies of inguinal hernia repairs have decreased in the UK and Turkey and now resemble the figures from North America.

Dabbas and colleagues reported a steady decrease in the female patient ratio between the 1980s and the 2000s.[3] In contrast, the female ratio increased in our study. Dabbas and colleagues also reported that inguinal hernia repairs occurred approximately 15 times more frequently in men than in women.[3] However, this fact is not the case in the present survey: inguinal hernia repairs were 10-fold more common in 2005, but this ratio decreased to only 7-fold in 2010. The female-to-male ratio of femoral and umbilical hernias is about 10:1 and 2:1 in textbooks, respectively.[17–19] In the present survey, these ratios are 1:1 for femoral hernia repair in both 2005 and 2010, whereas umbilical hernia repair is found to be 1.8-fold and 1.5-fold more frequent in females than in males. Historically, 51% of the hernias in women were inguinal, whereas 34% were femoral and 16% were umbilical in the UK at the beginning of 20th century, as reported by Eccles.[22] These rates are quite different from the results of our study (28%, 4.7%, and 28.8%, respectively).

The frequencies of umbilical and incisional hernia repairs were found to increase in the present survey. Umbilical hernia repairs increased 1.3-fold in 5 years. A similar increase was reported in the UK.[3] The reported frequencies for umbilical hernia repairs are now similar to the previously reported North American figures.[21] Interestingly, a recent systematic review of the volume and growth pattern

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of scientific papers on abdominal wall hernias revealed that the number of articles with the words "umbilical hernia" in the title displayed a 2.6-fold increase between 1991–2000 and 2001-1020,[23] perhaps indicating a worldwide increase in the number of umbilical hernia repairs. The most striking increase (3.9-fold) was reported for the number of articles with the words "incisional hernia" in the title in that review. The increase in the frequency of incisional hernia repairs in the present study is 1.5-fold, which is higher than that of umbilical hernia repairs. Incisional hernias differ from other abdominal wall hernias because of their iatrogenic origin; the most common cause is surgeon-related technical failures. The increase in incisional hernia repairs in the present study is possibly a consequence of the simultaneous increase in the number of all kinds of surgical operations including laparotomies and the number of general surgeons in Turkey.[24,25] In fact, the total number of hernia repairs did not rise after 5 years in the present survey in spite of a 2.6 annual increase in the population of Turkey. Therefore, the completion of laparotomies probably resulted in a higher prevalence of incisional hernias in our country. On the other hand, the 2-fold higher frequency of incisional hernia repairs in female patients compared with males may be the result of the higher number of cholecystectomies in women and cesarean sections.

In general, there may be a common factor explaining the increase in the total ratio of female patients, including all hernia repairs: the relative increase in the frequency of umbilical and incisional hernias, which are found in females more frequently, paired with the fact that the frequency of repairs for inguinal hernias, seen in women less frequently, has been decreasing. Repairs for both hernia types have risen 2-fold between 2005 and 2010.

Incarceration and strangulation are the most dangerous forms of a hernia that may cause morbidity and even mortality.[26,27] Urgent operations may be required in 5%–13% of abdominal wall hernia cases due to incarceration.[28] Similar results were obtained in the present survey. This study also revealed that the need for emergency repair has been increasing. Inguinal hernia repair is the most common procedure in an emergency setting, but it is not the type that most frequently causes emergency situations because of incarceration or strangulation. Instead, femoral hernias require emergency surgery in one out of every five cases, according to the present data. A recently published Dutch study also revealed that the rate of acute operations for inguinal hernia did not show an increase.[29] In the present study, umbilical hernias also seem to need emergency repair frequently. Previous studies have already revealed that the risk of incarceration is quite high for femoral and umbilical hernias; therefore, these hernias should be repaired in an elective setting when diagnosed.[26] The results of the present study also support this recommendation.

Recurrence is a specific problem in hernia repairs, causing not only additional consumption of healthcare resources but also requiring more difficult surgeries and even more postoperative complications.[30] The frequency of recurrent hernias has been steadily decreasing in a UK study from Southampton. In contrast, there seems to be a tendency for more frequent repairs of recurrent hernias in data from Turkey in the present survey. The cumulative prevalence of re-operation after a primary hernia repair is one of the main issues in the treatment of abdominal wall hernias. However, the present study was carried out by searching operation records; a follow-up of recurrence rates is beyond the scope of this study.

The most important development in hernia surgery is probably the introduction of tension-free repairs using prosthetic materials. These techniques are easy to learn and reduce the recurrence rates in the repair of almost every type of abdominal wall hernias. Therefore, mesh repairs have gained popularity all over the world. It is estimated that 20 million prosthetic meshes are implanted each year worldwide.[31] Aufenacker and colleagues reported that mesh use in inguinal hernia repair increased to 97.6% from 43.9% between 1994 and 2004.[29] Nevertheless, this case may not be true for ventral hernias like the umbilical, epigastric, and incisional types. Aslani and Brown's systematic review and meta-analysis revealed that the use of mesh in umbilical hernia repair results in less recurrence and similar wound complications rates compared with tissue repair for primary umbilical hernias.[32] Arroyo and colleagues also concluded by completing a randomized trial that prosthetic repair could become the standard treatment for primary umbilical hernia in adults.[33] Specific hernia centers prefer routine mesh for umbilical hernias,[16] however Witherspoon and O'Dwyer reported that the use of mesh is not routine in ventral hernia repairs; the vast majority of Scottish surgeons do not use meshes when the defect is less than 2 cm long.[34] This fact may be a consequence of the lack of guideline for ventral hernias, similar to the European Hernia Society guidelines for the treatment of inguinal hernia in

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adult patients.[35] The decrease in mesh use for elective umbilical hernia repair in the present survey is somewhat surprising. Surgeons in the studied centers might return to primary suture closure or Mayo repair for small umbilical hernias. As the authors do not have data on umbilical hernia defect sizes, it is not possible to draw a conclusion on this subject.

A recent meta-analysis revealed that emergency operation is a significant risk factor for surgical infection after mesh repair.[36] We found that meshes were used in most emergency groin and incisional repairs. However, this survey did not provide data about the infectious and other kinds of complications related to prosthetic material use in emergency hernia repairs. In the present study, prosthetic repairs were used more frequently in emergency umbilical, epigastric, and incisional hernia repairs than elective repairs for those types of hernias. This fact is probably due to large hernia defects encountered in acutely incarcerated or strangulated long-standing ventral hernias. Surgeons may find those defects too large to repair with sutures and may use a mesh in spite of its potential risks in emergency repairs.

The most frequently used prosthetic material in the repair of abdominal wall hernias is standard polypropylene mesh. It is cheap and reliable in most cases, especially for inguinal hernia repairs. The newer meshes are lighter and have larger pores, although they are more expensive. In the present search, the overall frequency of standard mesh use is about 95%. Lightweight meshes were mainly used in incisional hernia repairs.

The European Hernia Society guidelines propose the use of local anesthesia in all open repairs for all adult patients with a primary reducible unilateral inguinal hernia, whereas the guidelines are against the use of spinal anesthesia, especially using high dose and/or long-acting anesthetic agents.[35] However, is not easy to increase the local anesthesia rate in general hospitals even when surgeons who are experts in local anesthesia are employed.[37] Many surgeons are rather diffident about their capability of successfully performing local anesthesia. Furthermore, surgeons may display conservatism in their practice. In the present series, local and regional anesthesia has become more popular in inguinal hernia repairs. However, anesthesiologists often prefer regional anesthesia because of their ongoing clinical research during a certain period. Surgical teams do not request regional anesthesia according to current guidelines, but the regional anesthesia rate has increased almost 5-fold after 5 years. Regardless, in Turkey, intravenous sedation, together with local anesthesia, is a more cost effective method for anesthesiologists than regional or general anesthesia. Moreover, surgeons have to work with different anesthesiologists every week or month and therefore it may not be easy to establish a steady system for hernia repairs. Interestingly, another recent survey from the Netherlands showed that the rate of local anesthesia in inguinal hernia repairs stayed around 4% for ten years despite 86% of all repairs being done using open anterior techniques.[29]

Weakness of the study

Turkey has a population of 74 million people. The number of hospitals in Turkey is about 1400. Establishing a complete national database like that of the Swedish and Danish hernia registers is obviously quite challenging work in our country. This multicenter study presents data from 5 out of the 7 geographical regions of Turkey. Although some invited centers did not participate, this survey still has value in reflecting the picture of the whole country for the first time while providing important information about the hernia repairs and related preferences. To date, the only multicenter study in Turkey was an analysis of 34 Spigelian hernias from 6 institutions.[38] We hope that future work with additional participating institutions will provide more information about hernia surgery in Turkey. The ultimate goal for the presentation of hernia surgery data in Turkey should be an online national registry system.

In conclusion, the frequencies of abdominal wall hernia repairs have changed in Turkey. The fractions of female patients, emergency repairs, laparoscopic repairs, and the use of newer prosthetic materials have been increasing at different rates. Local and regional anesthesia techniques have become more frequently used in comparison with general anesthesia.

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