



Frequency of abdominal wall hernias: is classical teaching out of date?

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DECLARATIONS

Competing interests

None declared

Funding

None

Ethical approval

Not applicable

Guarantor

GTR

Contributorship

All authors

contributed equally

Acknowledgements

This paper was accepted for presentation at the Association of Surgeons of Great Britain & Ireland Annual Conference, Liverpool, April 2010 within the category 'Posters of Distinction'

Reviewer

Kapil Sugand

Summary

Objectives Abdominal wall hernias are common. Various authors all quote the following order (in decreasing frequency): inguinal, femoral, umbilical followed by rarer forms. But are these figures outdated? We investigated the epidemiology of hernia repair (retrospective review) over 30 years to determine whether the relative frequencies of hernias are evolving.

Design All hernia repairs undertaken in consecutive adult patients were assessed. Data included: patient demographics; hernia type; and operation details. Data were analysed using Microsoft Excel 2007 and SPSS.

Setting A single United Kingdom hospital trust during three periods: 1985–1988; 1995–1998; and 2005–2008.

Main outcome measures Frequency data of different hernia types during three time periods, patient demographic data.

Results Over the three time periods, 2389 patients underwent 2510 hernia repairs (i.e. including bilateral and multiple hernias in a single patient). Inguinal hernia repair was universally the commonest hernia repair, followed by umbilical, epigastric, para-umbilical, incisional and femoral, respectively. Whereas femoral hernia repair was the second commonest in the 1980s, it had become the fifth most common by 2005–2008. While the proportion of groin hernia repairs has decreased over time, the proportion of midline abdominal wall hernias has increased.

Conclusion The current relative frequency of different hernia repair type is: inguinal; umbilical; epigastric; incisional; para-umbilical; femoral; and finally other types e.g. spigelian. This contrasts with hernia incidence figures quoted in common reference books.

Introduction

An abdominal wall hernia is an abnormal protrusion of a peritoneal-lined sac through the

musculo-aponeurotic covering of the abdomen. Abdominal wall hernias are common, classically taught to occur in at least 2% of men¹ while statistics from the USA estimate 15 per 1000

population (1.5%).² More than 20 million hernias are estimated to be repaired every year around the world.³ Per year approximately 700,000 hernia repairs are carried out in the USA,⁴ and over 100,000 in the UK,^{5,6} bringing about a significant cost and morbidity burden.

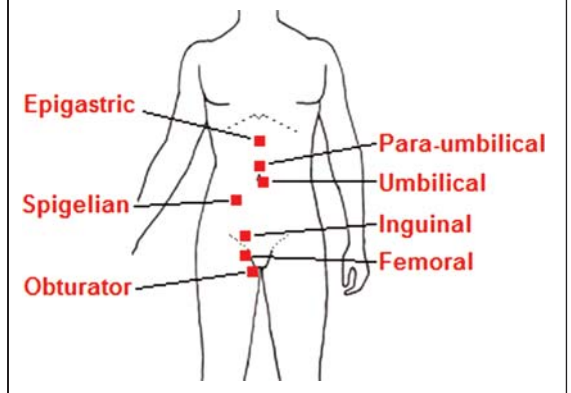
The introduction of independent treatment centres to produce additional capacity for some elective care (elective hernia repair being a prime example), with the aim of reducing waiting times and support the National Health System in meeting targets adds emphasis to this. Given the common nature of hernias, medical students are taught hernia epidemiology and examination techniques, and surgical trainees are often able to take advantage of their frequency to hone their surgical skills at a relatively early stage in training. Figure 1 shows the placement of various external hernias.

The most frequent hernia is the inguinal hernia (73% of cases).^{1,2,7} Various authors all quote the following order of hernias, in decreasing frequency: inguinal (70–75%), femoral (6–17%), umbilical (3–8.5%) followed by rarer forms (1–2%).^{1,2,8} But are these figures outdated? Anecdotally, it has seemed over the past few years that midline abdominal wall hernia repairs dominate day-case operating lists. We aimed to investigate the epidemiology of hernia repair over the past 30 years in order to determine whether the relative frequencies of abdominal wall hernias are evolving.

Methods

The number and type of hernia repairs undertaken in adult patients within a single hospital trust in the UK (Southampton University Hospitals Trust, incorporating Southampton General Hospital and The Royal South Hants Hospital) were documented for three 3-year time periods over three decades; Group A: October 1985 to September 1988; Group B: June 1995 to May 1998; and Group C: January 2005 to December 2008. Data were obtained from operating theatre registers and cross-referenced with the trust-wide HICSS computer database of coded operations. Data collated included patient demographics (gender, age), type of hernia repair undertaken, laterality where appropriate, and whether a primary or recurrent hernia. Both elective and emergency

Figure 1
Sites of external hernias



hernia repairs were included, and for the purposes of analysis, parastomal hernias were included under the category 'incisional hernia'.

Data were compiled and analysed using Microsoft Excel 2007 and SPSS 15.0 for Windows. Data were analysed with Spearman's Correlation, ANOVA regression or Chi-squared test as appropriate and is attributed where used in the results section.

Results

The total number of patients undergoing hernia repair over the three time periods was 2389: Group A – 426; Group B – 647; and Group C – 1316. There has been a significant increase in the number of patients undergoing hernia repair over time (Chi-squared test $p < 0.001$).

Over these periods, the total number of hernia repair procedures (i.e. including bilateral hernias and multiple hernias in a single patient) was 2510: Group A – 456; Group B – 675; and Group C – 1379, which also represents a significant increase over time (Chi-squared test $p < 0.001$).

Demographic data are shown in Table 1.

There is a small overall reduction in the age of patients over time with the mean age falling from 59.6 in Group A to 55.6 in Group C ($p = 0.002$ using ANOVA regression). (Although there was an even lower mean age in Group B, this did not reach significance.)

Inguinal hernia repair was the commonest hernia repair undertaken in all groups, however

Table 1**Demographic information pertaining to hernia repairs in Groups A, B and C**

	Group A (1985–1988)	Group B (1995–1988)	Group C (2005–2008)	Total
Total patients (<i>n</i>)	426	647	1316	2389
Total hernias (<i>n</i>)	456	675	1379	2510
Gender				
Men (% patients)	336 (78.9)	534 (82.5)	1096 (83.3)	1966 (82.3)
Women (% patients)	90 (21.1)	113 (17.5)	220 (16.7)	423 (17.7)
Age				
Mean/median	59.6/61	54.7/56	55.7/58	56.1/58
(range)	(21–90)	(18–89)	(17–92)	(17–92)
Frequency of recurrent hernia (% hernias)	38 (8.3)	53 (7.9)	84 (6.1)	175 (6.9)
Laterality (% unilateral right hernias – excluding bilateral)	190 (50.8)	272 (52.7)	433 (50.1)	895 (51.0)
Frequency of bilateral hernia (% groin hernia repairs)	30 (8.1)	28 (5.4)	63 (7.3)	121 (6.9)

there is has been a change in the proportion of other hernia repairs from Group A to C. Whereas femoral hernia repair is the second most common in Group A, it had become the fifth most common by Group C. The number of femoral hernia repairs in absolute terms, however, has not significantly changed over this time period ($p = 0.423$, Chi-squared test). All other types of hernia have significantly increased in numbers from Group A to Group C (inguinal $p < 0.01$, para/umbilical $p < 0.01$, epigastric $p < 0.01$, incisional $p < 0.01$, other $p < 0.01$, Chi-squared test). The increase in other types of hernias explains the relatively reduced proportion of femoral hernia repairs. Table 2 shows the relative frequencies of the types of hernia repair undertaken.

Of all inguinal hernia patients (total $n = 1656$), 1603 (96.8%) occurred in men and of all inguinal

hernia operations ($n = 1775$), 822 (46.3%) were left-sided. Of femoral hernias ($n = 93$), 59 (63.4%) occurred on the right side, 30 (32.3%) on the left side, and two (i.e. four hernias, 4.3%) were bilateral. Thirty-one (33.3%) femoral hernias occurred in men. Of the 349 para-umbilical/umbilical hernia repairs undertaken, 245 (70.2%) were carried out on male patients. There is no gender preponderance for epigastric hernia (86 [52.1%] men, 79 [47.9%] women).

In total, 175 repairs were carried out on recurrent hernias (6.9% of repairs). Over the three groups A, B and C, this was 38 (8.3%), 53 (7.9%), and 84 (6.1%), respectively. There was a trend towards a slight decrease in the proportion of recurrent hernias over time (Spearman's correlation co-efficient of -0.034), however this failed to reach significance, $p = 0.097$. There was variation in the recurrent hernia proportion between

Table 2**Distribution of types of hernia repairs undertaken in Groups A, B and C**

Type of hernia repair	Group A (1985–1988)	Group B (1995–1988)	Group C (2005–2008)	Study total
Inguinal, <i>n</i> (% repairs)	374 (80.3)	513 (76.0)	888 (64.4)	1775 (70.7)
Para-umbilical/Umbilical, <i>n</i> (% repairs)	22 (4.8)	65 (9.6)	262 (19.0)	349 (13.9)
Epigastric, <i>n</i> (% repairs)	18 (4.0)	28 (4.1)	119 (8.6)	165 (6.6)
Incisional (including parastomal), <i>n</i> (% repairs)	14 (3.1)	37 (5.5)	66 (4.8)	117 (4.7)
Femoral, <i>n</i> (% repairs)]	28 (6.1)	29 (4.3)	36 (2.6)	93 (3.7)
Other (mainly spigelian), <i>n</i> (% repairs)	0 (0.0)	3 (0.4)	8 (0.6)	11 (0.4)
Total hernia repairs	456	675	1379	2510

different hernia types; inguinal 148 (8.3%), femoral 3 (1.7%), para/umbilical 13 (7.4%), incisional 4 (2.3%), epigastric 7 (4.0%). There was a reduction in the number of recurrent femoral hernias from Group A to Group C (2 to 0), however due to the small numbers, this failed to reach significance ($p = 0.06$ Spearman's correlation co-efficient). There were no significant differences in the recurrent proportion of other hernia types over time.

Discussion

Abdominal wall hernia repair is a commonly performed general surgical operation, and therefore comprises a significant proportion of trainee teaching time.

Our results clearly differ from the classically taught order of hernia frequency (i.e. inguinal (70–75%), femoral (6–17%), then umbilical (3–8.5%) followed by rarer forms 1–2%^{8,9} (Figure 2). In fact, our results suggest an order of: inguinal; umbilical; epigastric; incisional; para-umbilical; femoral, and finally other hernia types, e.g. spigelian. More interestingly, our results seem to suggest that although the incidence of hernia by type in textbooks^{1,2} was accurate in the 1970s and 1980s, this has since changed. We sampled textbooks commonly used by medical students and junior surgical trainees as a measure to understand commonly accepted prevalence figures. Although newer editions of these textbooks are available,¹⁰ incidence figures quoted are the same, and we have been unable to find any

recently published figures pertaining to hernia incidence.

The choice of study design was based on a single unit, however one with a large and diverse catchment population (>1.3 million local population¹¹). Although the authors recognize that multicentre data would confer more generalizable conclusions, it was felt more important to obtain *complete* data. Similarly, the original study design included a plan to collect continuous data starting with the earliest records available (October 1985). It became apparent that the absolute numbers of hernia repairs would be very large and so a power calculation was made at three years, yielding an 80% power to the study. As data were available and complete for later 3-year intervals, we have included these as comparative cohorts.

Inguinal hernia

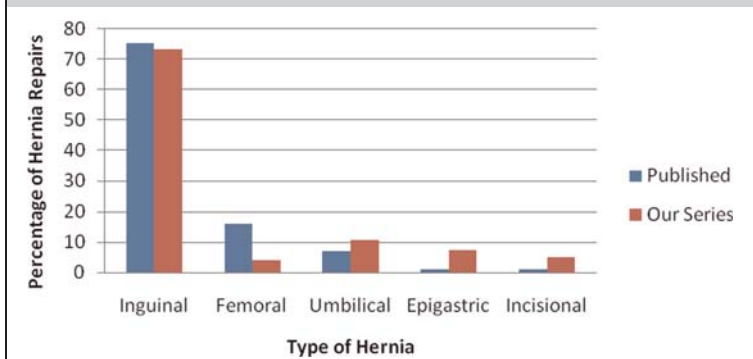
Inguinal hernia repair consumes a lot of health-care resources because it has a high lifetime risk; 27% for men and 3% for women.¹² Inguinal hernias are undoubtedly the commonest hernia type. Our results showed approximately 71% of all hernia repairs undertaken were inguinal, a figure slightly lower than the 75% quoted by various authors.^{1,9}

In England and Wales, approximately 10 elective inguinal hernia repairs per 10,000 population are carried out per year.¹³ The number of inguinal hernia repairs performed in NHS hospitals in England and Wales in 1998–1999 was 76,087, of which about 8% were for recurrence,¹³ compared with our figure of 8.3%.

Inguinal hernias are quoted as being 20 times more common in men than women.⁸ Our results are similar, in fact showing that inguinal hernia repairs were carried out in total almost 15 times more commonly in men than women. Inguinal hernias are also quoted to be right-sided in 55% of cases.⁸ Our results have mirrored this slight right predominance, with 49.0% left and 51.0% right-sided repairs.

Moreover, we have shown a trend towards a reduction over time in the proportion of groin hernia repairs, with a simultaneous increase in the proportion of midline abdominal wall hernia repairs. We postulate that a possible reason for

Figure 2
Graph comparing study results to previously published hernia frequency



these trends is the simultaneous trend towards increasing population body mass index (BMI). In fact, the proportion of the population classified as obese has more than doubled for men, and shown a similar but less steep trend for women even over the last 15 years.¹⁴

Femoral hernia

Classical textbooks quote femoral hernia as the third most common type of primary hernia.^{8,9} In our total study group, the rate of femoral hernia was only 3.7% (even lower during the time period 2005–2008), equating to the fifth commonest hernia type. In particular, femoral hernias are quoted as accounting for 20% hernias in women, and 5% in men.^{8,10} In fact, our results suggest femoral hernia account for less than 2% hernias in men, and just over 14% in women.

Other statistics quoted in the classical teaching include that femoral hernia are twice as common on the right side as the left.^{7–10} Our results did show preponderance of right-sided femoral hernia (2:1). Our results do suggest that the classical belief that femoral hernia are commoner in women than men remains true, but not as strongly as the four times commoner that has been quoted.⁹

Umbilical/Para-umbilical hernia

Textbooks also quote the rate of umbilical/para-umbilical hernia to be up to five times commoner in women,^{8–10,15} citing pregnancy as a significant aetiological factor. Our results are in complete contrast with this, showing that men in fact underwent more than twice as many umbilical/para-umbilical hernia repairs. Any condition which raises intra-abdominal pressure, such as a powerful muscular effort, may produce a hernia.⁸ Stretching of the abdominal musculature because of an increase in its contents, as in obesity, can be another factor. Adipose tissue acts to separate muscle bundles and layers, weakens aponeuroses and favours the appearance of para-umbilical, direct inguinal and hiatus hernias.⁸ Therefore obesity, physical strain and pregnancy are important aetiological factors in the development of both umbilical/para-umbilical hernias and epigastric hernias.

Our results however, have shown no difference in gender in epigastric hernias.

So why do our results differ to such a degree from long-believed teaching? We explore two major reasons. The first of these relates to parity in women. The total fertility rate in the UK has reduced significantly over this period. At the height of the 'baby boom' (1964) the mean number of children born to each woman in was 2.95, after which it steadily dropped to a low of 1.63 in 2001.¹⁶

Another factor that has been well-documented over the past half-decade is that of rising rates of obesity. In England, the proportion of men classed as obese increased from 13.2% in 1993 to 23.1% in 2005 and from 16.4% to 24.8% for women during the same period.¹⁴ Moreover, adipose deposition differs between genders^{17,18} and perhaps this contributes to gender differences in hernia formation. Men and postmenopausal women accumulate more fat in the intra-abdominal depot than do premenopausal women. It is feasible then, that this may lead to a relatively greater intra-abdominal pressure in men, predisposing to abdominal wall hernias. Moreover, as the population ages, there will be a resultant increase in the number of postmenopausal women who accumulate intra-abdominal adiposity thereby predisposing to hernia development. Over the last 25 years the percentage of the population aged 65 years and over increased from 15% in 1984 to 16% in 2009, an increase of 1.7 million people. This trend is projected to continue. By 2034, 23% of the population is projected to be aged 65 years and over.⁶

We have shown that there has been a great increase in the absolute number of hernia repairs of most types being undertaken in a single trust over the years. It is likely that this increase is mirrored in most hospital trusts throughout the UK as well as internationally, driven by increased health-care spending, day-case operating becoming commonplace, and the greater feasibility of elective surgery in the elderly. Perhaps another factor affecting these results may be that doctors recommend surgery for earlier, even asymptomatic hernias, which in the past were left until they became symptomatic. This may be as a result of new surgical (e.g. laparoscopic) and anaesthetic techniques perceived by referrers as 'safer', thereby allowing for repair on older and higher-risk surgical candidates.

We have shown a general trend towards fewer operations being carried out on recurrent

hernias. Our study period occurs over the era during which the use of mesh became commonplace (prior to 1982 the majority of inguinal hernia repairs in this hospital trust were carried out by Bassini or darn repair), which may part explain the reduction in recurrences. Our figure of 6.9% lies within the quoted 1–10%⁹ and is significantly better than earlier published recurrence figures.¹⁵

We do, of course, recognize important limitations to our study, not least of all its retrospective nature. Counting the number of hernia repairs as a proxy for hernia prevalence in a population will undoubtedly miss those patients who do not undergo operation for reasons of patient choice, anaesthetic risk, et cetera.

Conclusion

Abdominal wall hernia repair is a commonly performed general surgical operation. The relative frequency of groin hernia repair has decreased over time, while the frequency of midline abdominal wall hernia repair has increased. The relative frequency of different hernia type is: inguinal; umbilical; epigastric; incisional; para-umbilical; femoral; and finally other hernia types, e.g. spigelian. This contrasts with figures quoted in common reference books and may represent an evolution of disease pattern or surgical practice over the last 30 years.

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