

Inguinal Hernia Repair: Incidence of Elective and Emergency Surgery, Readmission and Mortality

PAOLA PRIMATESTA AND MICHAEL J GOLDACRE

Primatesta P (Unit of Health Care Epidemiology, Department of Public Health and Primary Care, University of Oxford, Oxford OX3 7LF, UK) and Goldacre M J. Inguinal hernia repair: incidence of elective and emergency surgery, readmission and mortality. *International Journal of Epidemiology* 1996; **25**: 835–839.

Background. Inguinal hernia repair is one of the most common operations undertaken in routine surgical practice. It generally carries a very low risk of major adverse sequelae. We analysed profiles, separately, for elective and emergency operations to report on the incidence and major adverse outcomes of inguinal hernia repair in a geographically defined population.

Methods. Age- and sex-specific hospital admission rates, emergency readmission rates within 30 days of discharge, and mortality rates, separately for elective and emergency operations, were calculated for the period 1976–1986 in the Oxford Record Linkage Study (ORLS) area.

Results. In all, 30 675 inguinal hernia repairs were performed in the area, an all-ages annual incidence of 13 per 10 000 population. Some 9% of patients underwent operation in an emergency admission. Elective operation rates remained constant over time. Emergency repairs decreased significantly over time in males. Patients who underwent emergency repair were older, had higher emergency readmission rates than those undergoing elective repair, and had significantly elevated postoperative mortality rates. In those who died it was uncommon for inguinal hernia to be recorded on their death certificates. Of the operations, 91% were undertaken on males; age-specific rates were highest in infants and the elderly; and emergency operation rates rose exponentially with age in people >50 years.

Conclusions. The lifetime 'risk' of inguinal hernia repair is high: at currently prevailing rates we estimate it at 27% for men and 3% for women. There is significant elevation of mortality after emergency operations. Elective repair of inguinal hernia should be undertaken soon after the diagnosis is made to minimize the risk of adverse outcomes.

Keywords: Inguinal hernia repair, inguinal hernia epidemiology, postoperative mortality, postoperative morbidity, avoidable deaths, lifetime risk

Inguinal hernia repair is the most common operation in general surgery in the US¹ and Europe.² Inguinal hernia is much more frequent in males than in females. Possible aetiological factors include an open processus vaginalis (found in all children with indirect hernia) and conditions which can raise intra-abdominal pressure, such as chronic bronchitis or hyperplasia of the prostate.³ While some elderly people, particularly women, may be unaware of their hernia until it strangulates, most of the cases are easily diagnosed. An early referral to the surgeon should mean short waiting times and elective surgery.

Elective surgery for inguinal hernia has a very low mortality (said to be <1 death per 10 000 operations⁴). By contrast, the risks of postoperative complications following an emergency operation are high, and in elderly patients mortality can be as high as 5%.⁴ The extent

to which health services are able to reduce emergency surgery, by scheduling operations as close to the time of diagnosis as possible, may be regarded as a good indication of their performance.

To provide information about the incidence of elective and emergency inguinal hernia repairs, early emergency readmissions and postoperative mortality, we studied data on inpatient admissions in a large, defined population covered by record linkage in the south of England.

METHODS

The Oxford Record Linkage Study (ORLS) can be used as a computerized register of all inpatients and day cases admitted to National Health Service hospitals in six districts of the Oxford region (total population 1.9 million people), with linkage of information about successive events (admissions and death) relating to the same patient. We identified all records in 1976–1986

Unit of Health-Care Epidemiology, Department of Public Health and Primary Care, University of Oxford, Oxford OX3 7LF, UK.

TABLE 1 Risk of admission for inguinal hernia repair in the subsequent years of life after each age: percentage of people projected to be admitted after each age

Age	Males	Females
0-	27.2	2.6
15-	23.5	1.9
30-	22.9	1.7
45-	21.1	1.5
65-	13.6	1.0
75-	8.3	0.7
80-	5.5	0.4

with the Office of Population Censuses and Surveys operation codes⁵ for inguinal hernia repair (410, 411, 415, 419) in any position on the record, and inguinal hernia coded as the main diagnosis on the record (8th Revision of the International Classification of Diseases codes⁵ 550.0, 552.0; 9th Revision of the International Classification of Diseases⁶ codes 550.0–550.9). After this period, following reforms to health information systems and to the National Health Service itself, routine hospital data ceased to be complete in England. Emergency and elective admissions were distinguished on the 'method of admission' codes. Day cases were defined as those patients whose admission was elective and who were operated on and discharged home on the same date of admission.

We calculated early unplanned readmission rates, defined as emergency readmissions within 30 days of discharge for patients who were discharged home after the operation, i.e. the denominator excluded patients who were transferred to another hospital or who died during the admission in which they underwent the operation. Postoperative mortality was calculated as the number of deaths after operation, wherever they occurred, at defined intervals per 1000 operations performed.

In making comparisons over time, rates were standardized by the indirect method, taking the age-specific rates in quinquennial age groups for all inguinal hernia operations (elective or emergency separately, as appropriate) performed over the 11-year period as the standard rates, and applying them to the population in each calendar year. Annual percentage changes in rates and their 95% confidence intervals (CI) were calculated by linear regression.

To determine the lifetime risk of operations on inguinal hernia we constructed a life table in 5-year age intervals (presented in broader age groups for simplicity in Table 1), using the combined incidence data for the period 1976–1986.⁸ Lifetime risk was calculated for

a life span of 85 years and an incidence of herniorrhaphy constant at the 1976–1986 levels.

RESULTS

There were 30 675 admissions with an operation on inguinal hernia. The inguinal hernia was the main diagnosis in 28 399 people which gave an all-ages annual incidence rate of 13 per 10 000 population. Of these, 2738 were emergency admissions (9%) and 27 937 were elective admissions (91%). Of the operations in emergency admissions, 573 (21%) were performed on patients <1 year old and 1133 (41%) on patients ≥65 years. The corresponding figures for elective procedures were 1088 (4%) and 6690 (24%) respectively.

Age- and Sex-Specific Admission Rates and Time Trends

In all, 91% (27 924) of repairs were done on males. After an initial peak in infants, the rates for elective surgery increased with age up to late middle-age and declined slightly in the elderly (Figure 1). The rates for emergency surgery in adults continued to increase with advancing age into very old age. The same rates, expressed on a log scale, are shown in Figure 2, to compare the distribution by age and sex within the elective and emergency categories. The exponential rise in emergency operation rates in the elderly is evident on the log scale. The median age for patients with emergency and elective repairs was 58 and 53 years respectively. Between 1976 and 1986 there was no significant change in admission rates for inguinal hernia repairs overall (age- and sex-adjusted annual percentage change 0.2, 95% confidence interval [CI] : -0.83, 1.2) or for elective admissions 0.4; 95% CI : -0.7, 1.6). Emergency repairs decreased significantly over time in males, by 1.2% per year (95% CI : 0.2, 2.3); they increased in females by 3% per year, but the increase was not significant (95% CI : -2.4, 8.6).

Day Surgery

Of the elective repairs, 1786 were done as day cases (6% of all repairs). Day case care was much more common for children than adults: it was undertaken on 34% of children <5 years. The percentage of hernia repairs done as day cases did not increase over time.

Readmissions

In all, 425 patients had an emergency readmission within 30 days of operation. Of the 1786 day cases, 17 were readmitted (1%), compared with 408 (1.5%) of the 26 613 inpatients. The difference was not statistically significant. The diagnoses most commonly recorded for

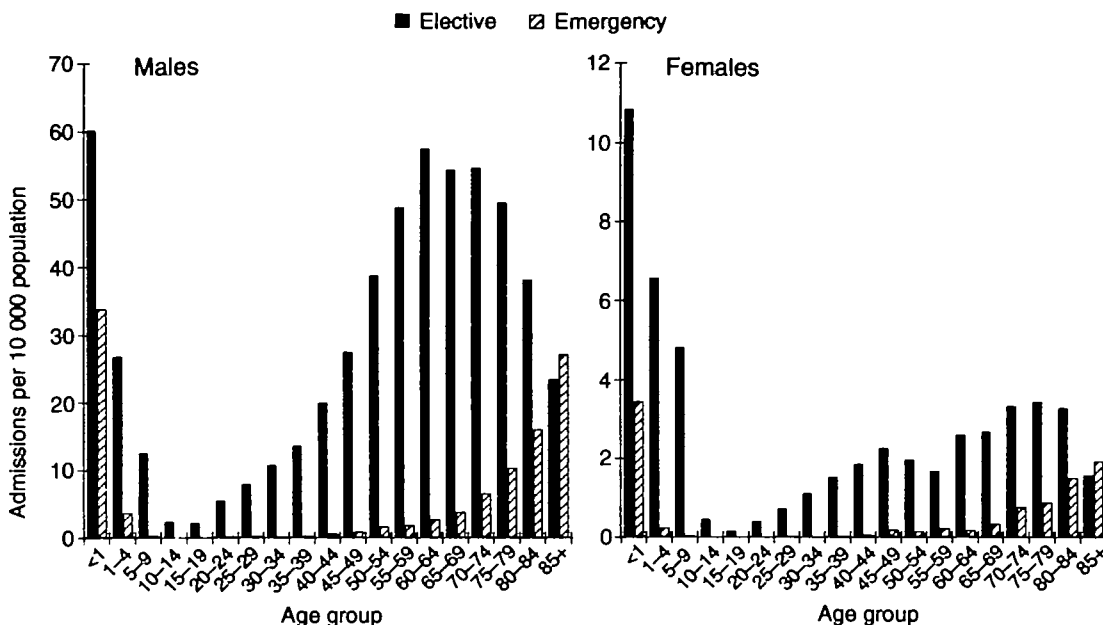


FIGURE 1 Age- and sex-specific admission rates for inguinal hernia repair in the Oxford region: 1976-1986 (NB different scales)

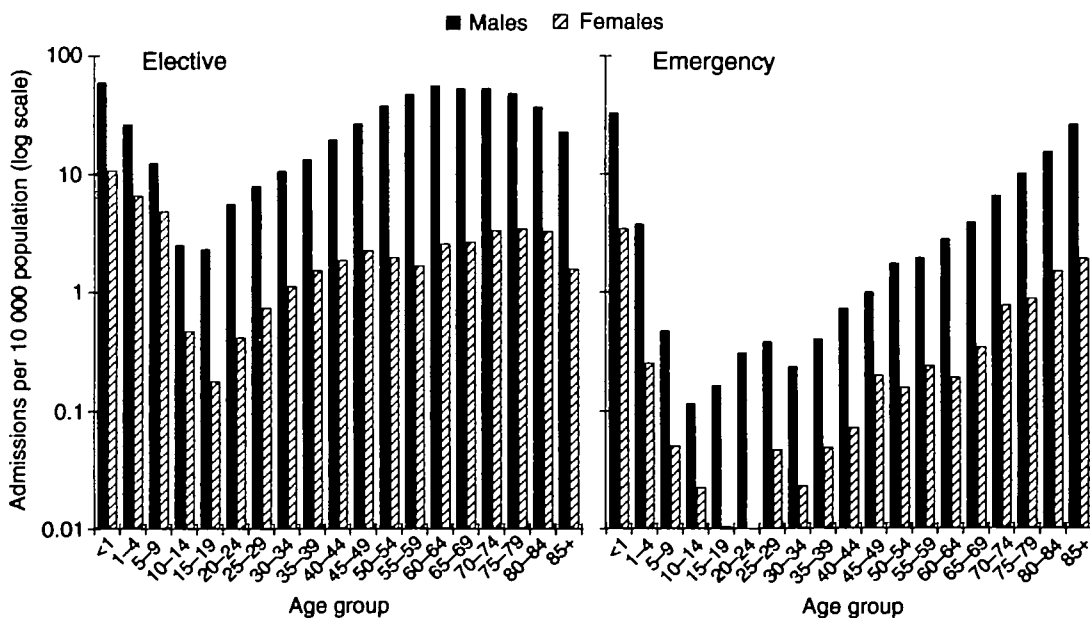


FIGURE 2 Age- and sex-specific admission rates for inguinal hernia repair in the Oxford region: 1976-1986

people with early unplanned readmission were: complications of the operation, e.g. postoperative infection and haemorrhage or haematoma (18%), deep vein thrombosis (8%), pulmonary embolism (7%), and other cardiovascular causes (7%). Eighteen of the 425 people

readmitted as emergencies within 30 days (4%) had a second operation on the hernia in the emergency readmission. Readmission rates were higher following an emergency index operation than following elective admission (age-sex standardized rates per 1000 operations

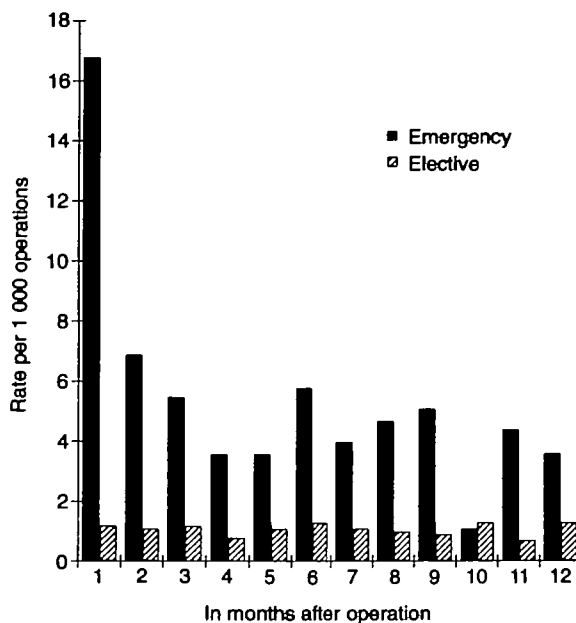


FIGURE 3 Death rates per 1000 hernia emergency and elective repairs per month in the year after operation

29 and 13.7 respectively, $P < 0.01$). They did not change significantly over time (annual percentage change -1.3 ; 95% CI: $-3.6, 1.1$).

Using record linkage we also identified hospital admissions for any cause during the 12 months that preceded the hernia repair. Of the people who had an emergency hernia repair, 389 (15%) had been admitted during the previous year, compared with 2188 of the elective repairs (8.5%, $\chi^2_{(1)} = 103, P < 0.01$).

Mortality

In the year after the operation there were 366 deaths following an elective procedure and 175 following emergency repairs. Age- and sex-standardized mortality rates per 1000 operations within 12 months of operation, comparing the two sources of admission, were 33.8 after an emergency repair and 14.4 after an elective repair ($\chi^2_{(1)} = 8.5, P < 0.01$). Death rates following elective hernia repair showed no postoperative clustering (Figure 3): they were evenly distributed over the first 12 months, and varied between 0.8 and 1.2 deaths per 1000 operations per month. In contrast, death rates in the first month after an emergency operation were significantly higher than those in subsequent months. The significant clustering suggests that at least half of the early deaths were probably attributable to the hernia itself, to the operation on it, or to the sequelae of

the operation. However, hernia was certified as the underlying cause of death in only eight of the 46 cases (17%). The most common certified underlying causes of death were cardiovascular causes (12 of the 46 patients died of ischaemic heart disease) and respiratory causes (10 died of bronchopneumonia). Higher mortality rates in people who underwent emergency surgery than in those with elective operations were evident throughout the first year after operation. There were no deaths in the first 3 months after operation in the 1786 day-case patients.

Lifetime Risk

Table 1 shows the cumulative lifetime risk for inguinal hernia repair from various ages. Assuming a constant incidence of inguinal hernia operations at the 1976–1986 levels, the lifetime risk from birth of undergoing such an operation was 27.2% for males and 2.6% for females.

DISCUSSION

The ORLS and the English national dataset, the Hospital In-patient Enquiry (HIPE),⁹ are almost independent datasets. The former included records of all hospital admissions in the area covered, and can be used for record linkage studies, while the latter was a one in ten sample and cannot be linked. The one in ten sample from the ORLS area comprises about 4% of national HIPE. The HIPE data⁹ show all-ages discharge rates for inguinal hernia operations varying between 13.1 per 10 000 population in 1979 to 13.7 in 1985 (when HIPE ceased), with little change over time, comparable to our findings. Consultation rates in general practice in England have also remained unchanged over time, according to the Second and Third National Studies in General Practice.^{10,11} According to HIPE, emergency admissions comprised 10% of all hospital episodes nationally, comparable with our figure of 9%. Day cases accounted for 4% of all operations on inguinal hernia nationally, and remained stable over the 1979–1985 period, compared with 6% in the ORLS area.

One of the most striking epidemiological features of inguinal hernia repair is its age and sex distribution. Over 90% of operations in our study were on men, with highest rates in infants aged <1 year. Of hernia repairs in infants, 10% were done with other operations on congenital anomalies, mainly on hydrocele or orchidopexy for undescended testis.

Elective repair of inguinal hernia is a low risk procedure which can be safely performed under general or

local anaesthetic, with few postoperative complications and very low mortality.¹² The Royal College of Surgeons of England, in its 1993 guidelines,¹³ stated that at least 30% of elective herniorrhaphy should be performed on a day-case basis. Nonetheless day-case surgery accounts for a much smaller proportion of inguinal hernia repairs in England than in the US, where it is reported to be more than 30%.¹ The proportion of cases done on a day-case basis has probably not increased much in England since the period covered by our study and the publication of HIPE.¹⁴

Hernia is considered an avoidable cause of death. However, it is difficult, from routine statistics, to know how many deaths are associated with it because, even when it is treated shortly before death, it is not commonly recorded as the underlying cause of death.¹⁵ We have shown that, of the people who died within 30 days of an emergency hernia repair, only 17% had inguinal hernia certified as the underlying cause of death. The short-term excess of mortality after emergency operations (Figure 3) suggests that the hernia or factors associated with it, or its treatment, were implicated in many such deaths in the first few weeks after operation. In addition to the short-term clustering, mortality was consistently higher following emergency than elective surgery throughout the first year after operation. This suggests that there is also a high background risk of mortality in patients who undergo emergency surgery for inguinal hernia¹⁶ which, in turn, reflects the probability that such patients tended to be at higher risk of serious illness generally than those who had an elective operation. We showed, for example, that they had more hospital admissions than elective patients in the year that preceded the hernia repair.

In the life table analysis we assumed a constant incidence of hernia repairs at the 1976–1986 level. Since there were no appreciable changes over this period, the assumption seems reasonable. At rates observed for 1976–1986, slightly more than one in four males and one in 37 females can expect to have an inguinal hernia repair during their lifetime.

The goal for hernia care should be to ensure that each patient undergoes operation when his or her risk of an adverse outcome, such as readmission, recurrence or death, is as low as possible. This should normally be achieved by elective repair soon after diagnosis. Short waiting times are needed to ensure that an elective repair is undertaken when patients are otherwise healthy, before the onset of concomitant disease, and to minimize the risk of obstruction.

ACKNOWLEDGEMENT

The Unit of Health-Care Epidemiology is funded by the Department of Health and the Anglia and Oxford Regional Health Authority. We thank Philip Morris for computing assistance and Kate Hey for producing the Figures.

REFERENCES

- ¹ Rutkow I M, Robbins A W. Demographic, classificatory, and socioeconomic aspects of hernia repair in the United States. *Surg Clin North Am* 1993; 73: 413–26.
- ² Editorial. British hernias. *Lancet* 1985; i: 1080–81.
- ³ Rains A J H, Ritchie D H. *Bailey & Love's Short Practice of Surgery*. London: Lewis & Co. 1984, Ch. 52.
- ⁴ Schumpelick V, Treutner K H, Arlt G. Inguinal hernia repair in adults. *Lancet* 1994; 344: 375–78.
- ⁵ Office of Population Censuses and Surveys. *Classification of Surgical Operations—3rd Revision*. London: OPCS 1975.
- ⁶ World Health Organization. *International Classification of Diseases 8th Revision*. Geneva: WHO, 1967.
- ⁷ World Health Organization. *International Classification of Diseases 9th Revision*. Geneva: WHO, 1977.
- ⁸ Kleinbaum D G, Kupper L L, Morgenstern H. *Epidemiologic Research. Principles and Quantitative Methods*. New York: Van Nostrand Reinhold Company, 1982, pp. 103–11.
- ⁹ Department of Health and Office of Population Censuses and Surveys. *Hospital In-patient Enquiry. In-patient and Day Case Trends. 1979–1985*. Series MB4, no 29. London: HMSO, 1989, pp. 14–15.
- ¹⁰ Royal College of General Practitioners, Office of Population Censuses and Surveys, Department of Health and Social Security. *Morbidity Statistics from General Practice. 1971–1972. Second National Study*. Series on Medical and Population Subjects no. 36. London: HMSO, 1979.
- ¹¹ Royal College of General Practitioners, Office of Population Censuses and Surveys, Department of Health and Social Security. *Morbidity Statistics from General Practice. 1981–1982. Third National Study*. Series MB5 no 1; London: HMSO, 1986.
- ¹² Behnia R, Hashemi F, Stryker S J, Ujiki G T, Poticha S M. A comparison of general vs local anaesthesia during inguinal herniorrhaphy. *Surg Gynecol Obstet* 1992; 174: 277–80.
- ¹³ *Clinical Guidelines on the Management of Groin Hernia in Adults*. London: Royal College of Surgeons of England, 1993.
- ¹⁴ Williams M, Frankel S, Nanchahal K, Coast J, Donovan J. *Epidemiologically Based Needs Assessment. Hernia Repair*. Health Care Evaluation Unit, University of Bristol, 1992.
- ¹⁵ Goldacre M J. Cause-specific mortality: understanding uncertain tips of the disease iceberg. *J Epidemiol Community Health* 1993; 47: 491–96.
- ¹⁶ Seagroatt V, Goldacre M. Measures of early postoperative mortality: beyond hospital fatality rates. *Br Med J* 1994; 309: 361–66.

(Revised version received November 1995)