

## Reduction in gastric cancer surgical mortality over 10 years: An adverse events analysis



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### ARTICLE INFO

#### Article history:

Received 31 December 2013

Received in revised form

25 February 2014

Accepted 3 March 2014

#### Keywords:

Gastric cancer

Surgery

Mortality

Hospital volume

Adverse events

Scotland

### ABSTRACT

**Background:** The reduction in gastric cancer mortality is due to a reduction in incidence and of surgical mortality. This study was to examine adverse events in patients with gastric cancer dying under surgical care.

**Methods:** Adverse events in surgical care were prospectively audited in patients who died of gastric cancer in Scottish hospitals. A cohort retrospective study examining deaths and contributing adverse events was compared for the periods 1996–2000 and 2001–2005.

**Results:** Between 1996 and 2005, 1083 patients with gastric cancer died on surgical wards in Scottish hospitals. The annual number of deaths under surgical care fell significantly from an average of 128 deaths per annum in years 1996–2000 to 88 deaths per annum in 2001–2005 ( $p < 0.001$ ). This occurred in parallel with the decline in gastric cancer incidence over the same period. There was an increase in the proportion of gastric cancer resections carried out in 7 major hospitals in Scotland in the second period of the study ( $p < 0.001$ ). The mean number of deaths in the group of patients, who had gastric cancer resection and palliative surgery, were significantly lower in the second period of the study. In addition, when all patients were considered as a group, the mean number of anaesthetic, critical care, medical management and technical surgery adverse events were significantly lower in the second study period.

**Conclusion:** There has been a reduction in deaths and adverse events for patients with gastric cancer under surgical care and this has been associated with surgical subspecialisation in oesophago-gastric cancer surgery.

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### 1. Introduction

Gastric cancer is the second leading cause of cancer specific mortality worldwide [1] and the 7th commonest cause of cancer death in Scotland (5th in males and 7th in females) [2]. Over a 10-year period, gastric cancer mortality has decreased by 27% [2] mainly as a consequence of declining incidence of gastric cancer [2] but also due to early diagnosis, improvements in staging techniques, technical improvements in surgery and availability of better anti-cancer drugs. Gastrectomy remains the only curative modality in the treatment of invasive cancer. However, the majority of patients have advanced disease at presentation and require palliation.

Several studies have demonstrated an inverse relationship between operative mortality and hospital volume for high risk

procedures including major cancer resections [3–6]. In the United Kingdom, the Calman–Hine report [7] commissioned by the Department of Health, in 1995 suggested the establishment of a network of specialised cancer centres, to improve outcomes in upper gastrointestinal cancer. Although the benefits are less clear than those for oesophageal surgery [8–10], it has been recommended that gastric cancer surgery should be performed in high volume units. Over the same period, the surgical community has adopted sub-specialisation in surgical practice with the establishment of specialist oesophago-gastric surgeons. Although the main reason for the decline in gastric cancer mortality is the reduced incidence of gastric cancer, the contribution of surgical sub-specialisation and centralisation of gastric cancer resections to units with high volume has not been evaluated as a separate entity. The aim of this study was to compare deaths and adverse events contributing to surgical mortality in patients with gastric cancer dying under surgical care over two periods before and after specialisation in surgical practice and centralisation of gastric cancer surgery.

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## 2. Patients and methods

Patients who died under surgical care from 1994 to 2005 (inclusive) with a diagnosis of gastric cancer (ICD10-C16) or keywords of “gastric” or “stomach” and “cancer” recorded as a cause of death were identified from the Scottish Audit of Surgical Mortality (SASM) database. SASM identifies all deaths that occur in hospital under the care of a surgeon during the patient’s last episode of care, whether an operation has taken place or not.

The process reviews the role of a single clinician and clinical teams both surgical and non-surgical in their contribution to the final outcome. The method of case assessment and the review process are well established [11–13]. In brief, deaths occurring within 30 days of an operation or during the patient’s last admission are collected via validated surgical and anaesthetic proformas which are anonymously assessed by a surgical assessor and by an anaesthetic assessor (if the patient had a surgical procedure under anaesthesia). The circumstances of death are described in terms of adverse events attributed to clinical issues for an individual, a team or hospital, to resource issues or to other individual causes. An adverse event can be defined as an unintended event caused by medical management, as opposed to the disease process, that results in patient harm (they are not necessarily complications). For patients who died within 30 days of surgery, the individual patient’s post-operative time scale was assessed by the case assessors in terms of its bearing on the adverse events that may have occurred in the post-operative course. Due to major changes in adverse event coding by SASM, the adverse events data before 1996 and after 2005 would not allow meaningful comparisons to be made.

Scottish hospital admission and operation data for gastric cancer for the study period were obtained separately from acute hospital discharge data, the Scottish Morbidity Record 1 (SMR1 returns) which identifies each defined episode of hospital care. Health related information in Scotland is collected in a national database which is managed by The Information and Statistics Division (ISD, Scotland) on behalf of NHS Scotland. ISD collects data from a variety of sources including SMR returns of inpatient admissions. The cancer database is part of this programme [2]. ISD also records deaths in Scotland in a separate but record link accessible death database (GRO) from the General Register Office in Scotland. All data are linked by a unique patient identifier, the Community Health Index number (CHI). The data from the SASM database was manually validated with data from the SMR01 returns and GRO database. Despite this manual validation, it is recognised that coding inaccuracies may occur in multi-sourced data [1415]. For the purposes of this study, the case assessors checked individual case notes when an adverse event was highlighted. For mortalities without an adverse event, validation was checked in 10% of the cases by reference to the case notes.

Data analysis was made using SPSS (SPSS Inc, Chicago, Illinois) in a quasi-experimental design looking at trends over time, accepting the application of events at certain time points. Data was assumed to be non-parametric and the dependence of categorical factors such as year and admission type was examined using two-way Chi-squared tests. Frequencies in categories were tested for equality with one-way Chi-squared tests. Statistical significance was accepted when the test statistic  $p$  was less than 5%.

## 3. Results

Between 1996 and 2005 the incidence of gastric cancer registrations in Scotland declined progressively from 988 patients in 1996 to 795 in 2005 ( $p < 0.001$ ). In addition, the recorded mortality from gastric cancer declined from 699 patients in 1996 to 590

patients in 2005 ( $p < 0.001$ ). During the same period, the annual number of gastric cancer surgery procedures recorded in Scottish hospitals decreased from 380 operations in 1996 to 221 operations in 2005 ( $p < 0.001$ ). However, there was a significant increase in the proportion but not the absolute numbers of cases operated on in the seven main cancer hospitals from 144/380 (38%) in 1996 to 146/221 (66%) in 2005 (Fig. 1).

### 3.1. Deaths

Over the study period, 1083 deaths (12% of the reported deaths) with a diagnosis of gastric cancer were audited by SASM. The annual number of deaths under surgical care fell significantly from an average of 128 deaths per annum in years 1996–2000 to 88 deaths per annum in the years 2001–2005 ( $p < 0.001$ ). As a proportion of all gastric cancer deaths reported to ISD, the annual proportion of patients dying in hospital under surgical care has decreased significantly from 18% in 1996 to 12% in 2005 ( $p < 0.001$ ). The median age at death was 74 years (range 22–101) and 61% of the patients were male. The majority of patients who died with gastric cancer were admitted to the surgical service as an emergency (54%) and the proportion of elective admissions decreased from 26% in 1996 to 20% in 2005.

Overall, 40% of patients with gastric cancer who died on a surgical ward were found to have advanced cancer and this has risen over the study period from 36% in 1996 to 59% in 2005 ( $p < 0.001$ ). Other co-morbidities were also found commonly in this cohort of patients (22% of patients had cardiovascular disease and 15% respiratory disease).

The mean number of deaths in the group of patients, who had gastric cancer resection and palliative surgery, were significantly lower in the second period of the study (Table 1).

### 3.2. Adverse events

Between 1996 and 2005 inclusive a total 1083 patients died following admission to the surgical wards in Scottish hospitals. One hundred and sixty five of these deaths (15%) were coded to have encountered 279 adverse events before death. The majority of deaths with adverse events had either a cancer resection (99/185 deaths, 175 events) or a palliative operation (47/179 deaths, 84 events). In addition, 4 adverse events were encountered in 4/75 deaths following endoscopy (2 diagnostic and 2 therapeutic), in 7/43 deaths (8 events) who had a surgical procedure unrelated to gastric cancer and in 8/601 deaths (8 events) who had no diagnostic or interventional procedure during their final admission.

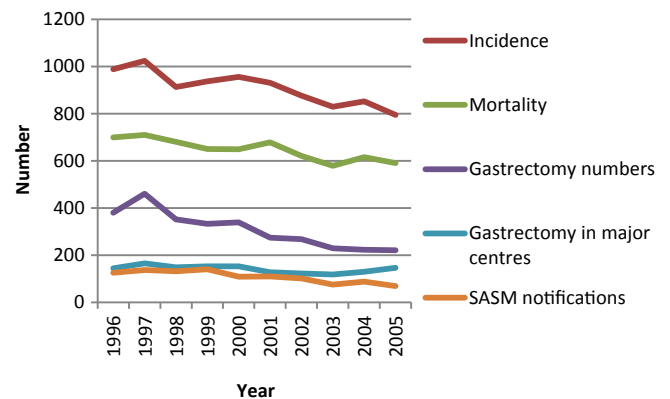


Fig. 1. Annual incidence, mortality and gastric cancer surgery statistics in Scottish Hospitals including SASM notifications of surgical deaths 1996–2005.

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