Specialisation and breast cancer survival in the screening era

D Kingsmore1, A Semwogerere2, D Hole*,2 and C Gillis2

1University Department of Surgery, Western Infirmary, Dumbarton Road, Glasgow G11 6NT, UK; 2Department of Public Health, University of Glasgow, 1 Lilybank Gardens, Glasgow G12 8RZ, UK

It is recommended that specialist surgeons treat all breast cancer, although the limited evidence to support this is based on treatment patterns prior to the introduction of screening. Whether a specialist survival advantage exists in the post-screening era is uncertain, as referral and treatment patterns may have changed, in addition to the effect of screening on the natural history of breast cancer. Our aim was to determine the impact of screening on the caseload and case-mix of specialist surgeons, to determine if the survival advantage associated with specialist care is maintained with longer follow-up and persists after the introduction of screening. Using the West of Scotland Cancer Registry, all 7197 women treated for breast cancer in a 15-year time period (1980–1994) in a geographically defined cohort were followed up for an average of 9 years, and pathological stage and socioeconomic status were linked with mortality data. We show that the caseload of specialists has increased substantially (from 11 to 59% of the total workload) and that smaller cancers have been selectively referred. However, even after allowing for pathological stage, socioeconomic status and method of detection, specialist treatment was associated with a significantly lower risk of dying (prescreening: relative risk of dying = 0.83, 95% CI = 0.75–0.92; post-screening: relative risk of dying = 0.89, 95% CI = 0.78–1.00). We conclude that this survival benefit is most consistent with effective surgical management rather than selective referral, the influx of screen-detected cancers or adjuvant therapies.

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Many studies have shown that treatment of breast cancer differs widely between types of hospital, geographical area and caseload of treating surgeon (LeeFeldstein et al, 1994; Sainsbury et al, 1995a, b). In an attempt to minimise variability, the Kings Fund (Kings’ Fund Forum Consensus Statement, 1986) and other professional associations subsequently (National Institutes of Health Consensus Conference, 1991) produced guidelines of treatment. All these guidelines recommend a policy of referral to a designated breast cancer team or specialist. However, in contrast to the number of guidelines published recommending specialist treatment, only three studies have reported a survival advantage associated with specialist care (Sainsbury et al, 1995a; Gillis and Hole, 1996). These were based on treatment that may be outdated, had limited follow-up and were conducted in the prescreening era. It is unclear whether the survival advantage demonstrated was a temporary delay to disease progression or a ‘curative’ advantage that persists with longer follow-up. In addition, none of these studies could ascertain the nature of the survival advantage associated with specialist treatment. Possible causes may include more unified multidisciplinary treatment, greater use of adjuvant therapies, selective referral and better case-mix. Indeed, the very implementation of protocols of treatment has been reported to reduce variability in treatment and improve outcome (Winstanley et al, 1995).

Population-based screening was introduced in 1988. A series of quality assurance guidelines were produced to ensure appropriate treatment of small screen-detected cancers, and included recommendations on pathological analysis, referral to specialist centres, multidisciplinary meetings and protocols. Thus, both referral of these small screen-detected cancers and treatment patterns may have changed, in addition to any impact of screening on the natural history of breast cancer itself.

The aim of this study is three-fold: firstly, to establish the impact of screening on the caseload and case-mix of specialist surgeons. Secondly, to determine if the survival advantage demonstrated in the prescreening era is maintained with longer follow-up, and thirdly, to ascertain if the survival advantage associated with specialist treatment persists after the introduction of screening.

PATIENTS AND METHODS

All women aged under 75 years with a histologically proven invasive breast cancer diagnosed between 1 January 1980 and 31 December 1994 were identified through the West of Scotland Cancer Registry. The study population was defined geographically using postcode sectors and formed the catchment areas for 10 hospitals and two screening centres (population base 1.5 million). Socioeconomic status was based on postcode sectors using the Carstairs’ deprivation index (Carstairs and Morris, 1988).

In total, 7673 women were identified and the pathology reports of 7197 (94%) were reviewed. The following pathological details were recorded: tumour size, axillary lymph node status (number examined and number positive) and grade. Dates and causes of death were obtained from the Registrar General for Scotland and
RESULTS

The percentage of women treated by specialists increased steadily from 11 to 59% of the total workload over the period of the study (Figure 1). In the prescreening era, specialists treated more women in the intermediate age category (47% vs 41%), and nonspecialists saw more women in the older age category (24% vs 31%) (Table 1). Postscreening, the difference in the age distribution was more pronounced (women <50 years = 55% vs 44%, 65 + years = 21% vs 30%). The percentage of all women in each age category treated by specialists doubled (<50 years from 25 to 50%, 50 – 64 years from 26 to 58%, 65 + years from 20 to 43%).

The case-mix and caseload were similarly analysed by tumour size, nodal status and deprivation category (Table 2). Prior to screening, the only significant difference in case-mix between specialists and nonspecialists was the distribution by socioeconomic status (specialists treating more women in the affluent and deprived categories), although the trend across the deprivation categories was not significant. However, in the postscreening era, specialists treated women with smaller cancers (<10 mm: 16 vs 5%, 10 – 19 mm: 36 vs 33%, 20 – 39 mm: 57 vs 47%, 40 + mm: 11 vs 15%; P < 0.001). The distribution of nodal status was also significantly different, although both groups treated a higher percentage of node-negative women postscreening.

The 5-year survival of all women, irrespective of who treated them, improved from 60% in the prescreening era to 73% postscreening (relative hazard ratio (RHR) = 0.58, 95% CI = 0.53 – 0.62, P < 0.001 adjusted for age). This could not be accounted for by changes in patterns of treatment, tumour size, nodal status, deprivation category, screening status or age-distribution (RHR = 0.77, 95% CI = 0.71 – 0.83, P < 0.001, after allowing for these variables).

The survival advantage associated with specialist treatment of women in the prescreening era persists with the addition of 4 extra years of follow-up, compared with our previous publication (RHR = 0.83, P < 0.001, Table 3). This benefit was also seen in the postscreening era (RHR = 0.89, 95% CI = 0.78 – 1.00, adjusted for tumour size, nodal status, deprivation category, screening status and age). However, the survival benefit associated with specialist treatment decreased in the postscreening era from a 17% reduction in the risk of dying (RHR = 0.83 postscreening) to an 11% reduction (RHR = 0.89 postscreening). Analysing breast-cancer-specific mortality did not alter this survival advantage.

The reduction in the risk of death associated with specialist treatment was seen in those women with tumours smaller than 4 cm (Table 4). The survival benefit was maximal in women with...
tumours smaller than 4 cm (8% difference in 5-year survival), with 4+ nodes positive (17% difference in 5-year survival), in women aged 50–64 years (13% difference in 5-year survival), and in the most deprived women (10% difference in 5-year survival).

**DISCUSSION**

This study has shown that while the caseload of specialists has steadily increased over a 15-year period and the case-mix has altered with the implementation of the national screening programme, the survival advantage associated with specialist treatment has persisted with longer-term follow-up (median 13 years) and is also apparent in the postscreening cohort of women (median follow-up 6 years).

In this and the previous study (Gillis and Hole, 1996), surgeons were chosen as specialists on the basis of local surgeons’ opinions of who exhibited a particular interest in breast cancer. The specialists shared several common characteristics, for example, keeping separate records of women they treated for breast cancer, entry into clinical trials, and a multidisciplinary approach to treatment. While these are vague characteristics, it must be remembered that at the time of that study there was no subspecialisation of surgical services. Indeed, the definition of ‘specialisation’ remains very variable. Other studies have used hospital type (McArthy and Bore, 1991; Basnett et al., 1992), caseload (Sainsbury et al., 1995a), affiliation with oncological services (Scorpiglione et al., 1995) and membership of local associations (Sainsbury et al., 1995b). While these criteria may allow simple differentiation into contrasting groups, they are also indirect measures of adequate and appropriate treatment. Thus, we feel that although our definition is subjective and not widely applicable, it has validity, being based on the opinion of peers, and accurately represents the focused training, dedicated interest, awareness of

Table 2  Case-mix of specialist and nonspecialist surgeons by time period and age

| Time period | Factor          | Specialists | Nonspecialists |
|-------------|-----------------|-------------|----------------|
|             | n   | %   | n   | %   | % treated by specialists |
| Prescreening| Tumour size (mm) |             |               |             |                  |
|             | <10  | 34  | 5   | 94  | 5   | 26 |
|             | 10–19 | 180 | 25  | 534 | 26  |
|             | 20–39 | 337 | 46  | 972 | 47  |
|             | 40+  | 173 | 24  | 448 | 22  |
|             | $\chi^2$  |       |           |            |
|             | 0.75  |       |           |            |
|             | P     |       |           | 0.39        |
|             | Nodal status |             |               |             |                  |
|             | Negative   | 387     | 50  | 837 | 46  | 32 |
|             | Positive   | 388     | 50  | 983 | 54  | 28 |
|             | $\chi^2$  |       |           |            |
|             | 3.24  |       |           | 0.07        |
|             | P     |       |           | 0.07        |
|             | Deprivation category |      |               |             |                  |
|             | Affluent   | 231     | 25  | 554 | 19  | 29 |
|             | Intermediate | 345   | 38  | 1366 | 48  | 20 |
|             | Deprived   | 341     | 37  | 949 | 33  | 25 |
|             | $\chi^2$  |       |           | 0.41        |
|             | P     |       |           | 0.52        |
| Postscreening| Tumour size (mm) |             |               |             |                  |
|             | <10  | 250  | 16  | 63  | 5   | 80 |
|             | 10–19 | 549  | 36  | 441 | 33  | 55 |
|             | 20–39 | 559  | 37  | 638 | 47  | 47 |
|             | 40+  | 168  | 11  | 199 | 15  | 46 |
|             | $\chi^2$  |       |           |            |
|             | 90.90  |       |           | <0.001      |
|             | P     |       |           | 0.001       |
|             | Nodal status |             |               |             |                  |
|             | Negative   | 848     | 59  | 639 | 55  | 57 |
|             | Positive   | 586     | 41  | 525 | 45  | 53 |
|             | $\chi^2$  |       |           | 4.54        |
|             | P     |       |           | 0.03        |
|             | Deprivation category |      |               |             |                  |
|             | Affluent   | 446     | 25  | 294 | 18  | 60 |
|             | Intermediate | 767   | 43  | 840 | 52  | 48 |
|             | Deprived   | 566     | 32  | 498 | 30  | 53 |
|             | $\chi^2$  |       |           | 5.42        |
|             | P     |       |           | 0.02        |

Table 3  Survival of women treated by specialist and nonspecialist surgeons by time period

| Time period | All cause mortality | Breastcancer specific mortality |
|-------------|---------------------|-------------------------------|
|             | 5 years | 10 years | RHR  | 5 years | 10 years | RHR  |
| Prescreening| 67%     | 49%      | 0.83 | (0.75–0.92) |
| Postscreening| 77%   |           | 0.89 | (0.78–1.00) |
| Prescreening| 71%     | 64%      | 0.82 | (0.73–0.92) |
| Postscreening| 81%   |           | 0.89 | (0.77–1.02) |

RHR = Relative hazard ratio (95% confidence limits), adjusted for tumour size, age group, socioeconomic status, year of diagnosis and method of detection.
current treatment and concentration of service provision that underlies the premise of better treatment with specialisation.

The caseload of specialists doubled in the time period studied. Unexpectedly, this increased workload was not due solely to an influx of screen-detected cancers, but a steady incremental growth that started before screening. Although the pre-screening case-mix between specialists and nonspecialists was the same, after screening there was selective referral to specialists of younger women and smaller, screen-detected tumours. Almost half of all women treated by specialists in the age group 50–64 years, the age group offered screening, were screen-detected. However, it is interesting that in this same age group, 14% of women treated by nonspecialists had also been screen-detected. This re-enforces our premise that specialisation is not easily categorised, and that simply defining categories, for example, teaching hospitals vs district hospitals, does not necessarily correlate with quality of treatment.

Survival differences between the two groups of surgeons could be accounted for by differences in tumour size (lead-time bias) and also by method of tumour detection (length-time bias). Length-time bias was a possible confounding factor as screening may preferentially detect slower growing, more favourable tumours (Duffy et al., 1991; Klemi et al., 1992). This was confirmed, as the method of detection remained a highly significant variable in the survival analysis after allowing for all other factors (RHR = 0.59, P < 0.001).

We examined survival by two well-recognised methods to allow for the difference demonstrated in case-mix between specialists and nonspecialists. Firstly a multivariate analysis was performed and variables of tumour size, nodal status, age, method of detection and deprivation category were included as independent variables. Secondly, the data were stratified according to the above variables with the others included as independent variables. The benefit associated with specialist treatment was maximal in smaller, node-positive tumours, but also seen in all ages and socioeconomic groups. Given the size of the survival differences and the groups in which it is maximally seen, the survival benefit would not therefore be consistent with purely differential prescription of chemotherapy or endocrine therapy.

It is interesting to note that the survival benefit was not seen in tumours larger than 4 cm. Recent evidence suggests that local treatment and thus local recurrence may lead to dissemination of disease and poorer survival (Overgaard et al., 1997; Ragaz et al., 1997). It is very unlikely that tumours greater than 4 cm would have been suitable for or treated by breast conserving surgery. Thus, it is unsurprising that there is no difference in survival between specialists and nonspecialists in women with large tumours, as both will have been equally treated with mastectomy. Furthermore, women with advanced tumours are more likely to have disseminated disease and poorer survival (Overgaard et al., 1997). It is very unlikely that tumours greater than 4 cm would have been suitable for or treated by breast conserving surgery. Thus, it is unsurprising that there is no difference in survival between specialists and nonspecialists in women with large tumours, as both will have been equally treated with mastectomy. Furthermore, women with advanced tumours are more likely to have disseminated disease at the time of diagnosis, and thus it is logical that any survival difference caused by local treatment will be overwhelmed by the overall poorer survival in this group of women.

Overall, 5-year survival between the two time periods has improved considerably (from 60 to 73%). The cause of this improvement is hard to determine, but could not be accounted for by changes in referral patterns, screening or case-mix in the multivariate analysis. It is unlikely that this can be solely because of increasing use of chemotherapy or endocrine therapy.

We conclude that while the nature of this survival benefit remains elusive, we are confident that it is real, persistent, and most consistent with effective surgical management rather than selective referral, the influx of screen-detected cancers, or adjuvant therapies.

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| Table 4 | Survival of women treated by specialist and nonspecialist surgeons by tumour size, nodal status, age, socioeconomic status |
|---------|-----------------------------------------------------------------------------------------------------------------|
| **Factor** | **5-year survival (%)** | **Specialists** | **Nonspecialists** | **RHR** | **95% CI** |
| Tumour size (cm) | | | | | |
| <2 | 89.9 | 81.6 | 0.78 | (0.64 – 0.91) |
| 2–3.9 | 76.6 | 68.5 | 0.79 | (0.69 – 0.92) |
| 4+ | 49.6 | 51.1 | 0.99 | (0.83 – 1.19) |
| Nodal status | | | | | |
| Negative | 88.7 | 84.1 | 0.82 | (0.70 – 0.95) |
| 1–3 nodes positive | 73.9 | 63.3 | 0.75 | (0.65 – 0.88) |
| 4+ nodes positive | 57.3 | 40.0 | 0.81 | (0.69 – 0.88) |
| Age group (years) | | | | | |
| <50 | 75.7 | 69.5 | 0.79 | (0.68 – 0.93) |
| 50–64 | 78.4 | 65.7 | 0.83 | (0.74 – 0.93) |
| 64–74 | 73.6 | 66.8 | 0.89 | (0.77 – 1.02) |
| Socioeconomic status | | | | | |
| Affluent | 79.3 | 70.6 | 0.88 | (0.74 – 1.04) |
| Intermediate | 77.3 | 68.0 | 0.83 | (0.74 – 0.94) |
| Deprived | 73.8 | 63.5 | 0.82 | (0.72 – 0.93) |

Adjusted for tumour size, nodal status, age, method of detection and socioeconomic status; 95% CI = 95% confidence interval.
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