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Effect of hospital volume on processes of care and 5-year survival after breast cancer

The link between a higher survival rate after a diagnosis of breast cancer for high volume hospitals compared to low volume hospitals has been consistently demonstrated over the last ten years. Less frequent are studies on the differences in processes of care between high and low volume providers. In Belgium, a set of 11 process indicators to assess the quality of the treatment of breast cancer has been recently constructed, tested and validated. Building on this previous work, the present study aimed at comparing overall survival and 11 processes of care by hospital volume in Belgium.

How Does It Work?

Three national databases were linked using a unique anonymous patient identifier:

1. The Belgian Cancer Registry database. It contains clinical information (date, staging) of all new primary invasive breast tumours. For this study, all women with a cancer incidence date between 1 January, 2004 and 31 December, 2006 were selected.

2. The Claims database hosted by a national consortium of all sickness funds. It contains detailed information on all reimbursed pharmaceutical products, consultations, diagnostic and therapeutic procedures, both in hospital and ambulatory settings.

3. The Belgian population database. It contains the vital status of all citizens living in Belgium.

Hospital volume was based on the annual number of patients treated by the centre and was computed as the average volume over 2004, 2005 and 2006. Hospitals were categorised as very-low-volume hospitals (50 patients per year), low-volume hospitals (50-99 patients per year), medium-volume hospitals (100-149 patients per year) and high volume hospitals (≥150 patients per year). The last cut-off corresponds to the minimal recommended size by the European Society for Breast Cancer Specialists (USOMA), by the European directive on breast cancer treatment and by the 2007 legislation in Belgium (after a transition period where volume of 100 was accepted or allowed).

Process and outcome indicators were retrieved by a systematic literature search, including international and Belgian clinical guidelines. The quality indicators were pilot tested using Belgian Cancer Registry data and claims data from 50,039 women with invasive breast cancer over a five-year period. A final set of 11 process indicators was measurable, showing results that largely correspond to other studies in the field.

Cox proportional hazard models were used to assess the influence of the annual patient volume on the five-year survival, adjusting for patient's age, cancer stage and grade. Logistic regression models were used to assess the influence of volume on the probability that a process indicator occurred, without any adjustment for differences of populations.

Results

A total of 25,178 women diagnosed between 1 January, 2004 and 31 December, 2006, and treated in 111 hospitals were included in the study. Half of the hospitals (N = 57) were labelled as "very-low-volume" and treated 20% of the cohort. Only 14 hospitals were labeled as "high-volume" and treated 38% of the patients.

The mean age of the cohort was 60.8 years. Patients treated in very-low-volume hospitals were almost four years older on average than patients treated in high-volume hospitals. The completeness of reporting pathological data (stage and grade) was much better in high volume hospitals (94%) than in very low volume hospitals (85%). However, the distribution of reported stages and grades was largely similar across hospitals, whatever their annual volume.

The observed five-year survival was 80.2% for the entire cohort with variations according to the annual volume: 74.9%, 78.8%, 79.8% and 83.9% for patients treated in very lowvolume, low-volume, medium-volume and highvolume hospitals respectively. After case-mix adjustment for age, stage and differentiation grade, patients treated in very-low-volume hospitals had a hazard ratio (HR) for death of 1.26 (95% CI 1.12, 1.42) compared to patients treated in high-volume hospitals. Patients in low-volume hospitals also had an increased risk of death compared to patients in high-volume hospitals (HR 1.15; 95% CI 1.01, 1.30). Age, stage and differentiation grade were found to be prognostic factors for five-year

survival.

Among a set of 11 processes studied, six were more often performed in high-volume hospitals: More frequent multidisciplinary team meetings (MDT), more frequent use of appropriate diagnostic and staging techniques (cytological and/or histological assessment before surgery), more frequent use of breast-conserving surgery (BCS), and more frequent use of adjuvant therapies having an impact on overall survival (radiotherapy after BCS), and finally more adequate follow-up strategy (followup mammography within the first year post treatment). All details are presented in Table 1.

The five remaining process indicators showedno differences between low volume and high volume centres.

Limitations

There are four limitations to our study. Firstly, it is based on rather old data (2004-2006), and some changes in the organisation of care in Belgium were introduced since then, such as the formal recognition of breast clinics since 2007. Nonetheless, the results can serve as a baseline to follow up the quality of care in the future.

Secondly, our analysis does not account for the effect of surgeon volume, a variable which has been shown to be a prognostic factor for survival from breast cancer. However, as high-volume surgeons tend to operate in high-volume hospitals, part of the effect that was attributed to the hospital is probably due to the experience of the surgeon. Also, we did not investigate whether the observed effects could be explained by other characteristics of the hospitals, such as teaching status or geographical location (urban or country).

Thirdly, it cannot be excluded that the observed survival differences between low- and high-volume hospitals are due to patient characteristics other than those accounted for in our study, such as social status, co-morbidity, or other residual confounding variables. Although this is a possible explanation for the observed survival differences, it is not consistent with the differences observed in processes of care, which residual confounding cannot explain.

Finally, all process indicators were calculated based on claims data. In the unlikely but not unrealistic event that a process was performed but not billed, it could not be identified in our study.

Discussion

This study has shown that several processes of care are more often performed in high-volume centres compared to low-volume centres. Some hypotheses are formulated below.

• Differences in breast conserving surgery rates could be explained by the higher technical skills needed to perform BCS compared to mastectomy, expertise that is probably more frequently available in high-volume centres.

• Differences in use of neoadjuvant treatment could also be partly explained by the choice for BCS or mastectomy, as neoadjuvant treatment is intended to reduce tumour size and hence to increase the likelihood of BCS. These differences could also be attributed to a higher proportion of MDT meetings in high-volume centres, which has been shown to change the surgical management of patients, owing to the additional information in mammographic and pathologic interpretation as evaluation by medical and radiation oncologists and surgical breast specialists.

• A possible explanation of the differences in the use of adjuvant radiotherapy after BCS is that this recommendation is based on a relatively recent systematic review of the Early Breast Cancer Trialists Collaborative Group, and that high volume hospitals may pick up new evidence more quickly than low-volume centres. Furthermore, most high-volume centres have their own radiotherapy centre, which is not the case for low-volume centres. The latter could be reluctant to transfer their patients for adjuvant radiotherapy in another hospital. An exploratory analysis of our data showed that high-volume centres also more frequently provide radiotherapy after mastectomy (50.9% in very-low-volume hospitals, 57% in low and medium-volume hospitals, and 65.7% in high volume hospitals; data not shown), confirming the latter hypothesis.

• The lower rate of diagnostic mammography or breast ultrasonography in high-volume hospitals (80% versus about 90% in other hospitals) is somewhat surprising and could be explained by the use of alternative imaging procedures such as Magnetic Resonance Imaging.

• Also, the lower rate of systemic treatment for patients with metastatic cancer in high-volume hospitals, which are also often academic hospitals, is perhaps explained by the increasing recruitment of these patients in clinical trials. In Belgium, costs of the experimental treatment are supported by the industry, are not reimbursed and hence not registered in the claims database. This hypothesis should be further validated.

Conclusion

The present study showed that women with invasive breast cancer treated in very low-volume hospitals (<50 patients per year) and in low-volume hospitals (50-99/year) had a higher risk of death within five years after diagnosis than women treated in high-volume hospitals (≥150/year). The increased mortality risk was higher for very low-volume hospitals (26%) than for low-volume hospitals (15%). In addition to the relationship between hospital volume and survival, our study showed large differences in the application of evidence-based processes between hospitals according to their volume. Among a set of 11 processes studied, six were more often performed in high-volume hospitals.

These results should not really surprise the informed reader, as differences in processes of care across volume categories have already been reported for other cancer types (such as bladder cancer or esophageal cancer) and in high-risk cancer surgery. Also in other domains of care, such as cardiology, the link between process and volume has been extensively studied, and showed similar results.

In conclusion, survival benefits reported in high-volume hospitals suggest a better application of recommended processes of care, justifying the centralisation of the management of breast cancer patients in these hospitals.

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