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Original article

Variations in the breast reconstruction rate in France: A nationwide study of 19,466 patients based on the French medico-administrative database

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ABSTRACT

Background: Access to breast reconstruction (BR) surgery after a mastectomy remains limited, with a large degree of national and international variation despite its known psychological benefits and impact on quality of life. The aim of this study was to investigate the factors influencing breast reconstruction in France where cancer-related healthcare costs are fully reimbursed.

Methods: All primary mastectomies for breast carcinoma performed in 2012 and linked BR surgeries from 2012 to December 2015 were extracted from the French medico-administrative database. A three-level logistic regression analysis was performed to model the probability of breast reconstruction according to patient, hospital and administrative region characteristics.

Results: Among the 19,466 women who had a mastectomy in 2012, 5328 (27.4%) had breast reconstruction. Multivariate analysis showed that the BR rate was lower in patients living in an area with an unfavourable socioeconomic level ($p < .001$), in low volume hospitals ($p < .001$), and in public hospitals (18.6%) compared to private hospitals (25.9%), university hospitals (29.8%), and cancer centres (35.0%) ($p < .001$). BR rate was significantly lower in patients older than 65 compared to those younger (7.5% versus 42.1%, $p < .001$). The impact of age was even greater in public hospitals than in other centres (interaction test, $p = .001$). We also observed significant heterogeneity in the BR rate across regions, which could be partially explained by differences in the plastic surgeon density.

Conclusions: Breast reconstruction rate heterogeneity could be attributed to women choice. However, our study suggests that unequal access to high-quality procedures also plays a role, particularly for older breast cancer women.

Introduction

Breast cancer is the most frequent cancer in women in Europe, with 464,000 new cases each year and 54,062 new cases in France in 2015 [1,2]. With improved treatment options resulting in a 10-year survival rate of 76%, it is essential to pay particular attention to the patient's quality of life [1]. Breast conserving surgery is performed as often as possible however, mastectomy is still needed in approximately 30% of the women treated for breast cancer [3]. For these patients, the benefit of breast reconstruction (BR) on quality of life has been widely reported due to improved physical, psychosocial and sexual well-being [4–6].

A review of the international literature showed significant variation in BR rates, which ranged from 4.9% to 81.2%, depending on the patient and tumour characteristics, surgeon/hospital and on psychological factors including patient choice. Among these considerations, age appears to be an important factor that influences BR rates [7]. In France, although the cost of BR is covered by national social insurance and is recommended by public health authorities, the proportion of women who opt for BR remains low

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(approximately 20% before 2012) [8].

The goal of this study was to investigate factors that influence BR in France in recent years by examining patient characteristics, especially patient age, as well as hospital features, regional medical access, and the interactions between these factors.

Materials and methods

Patients

We used the French hospital stay database (Programme de Médicalisation des Systèmes d'Information, PMSI, secured access https://acces-securise.atih.sante.fr/vpn/index.html) to identify the population of women who underwent a mastectomy for breast cancer (BC) in 2012 and to identify whether or not these patients had BR. PMSI is a comprehensive medico-administrative database that routinely collects inpatient care data from all French hospitals. Information includes demographic data, place of residence (municipality code), dates of each stay, diagnostic codes based on the 10th version of the International Classification of Diseases (ICD-10, http://apps.who.int/classifications/icd10/browse/2016/en), diagnosis-related group, and the procedures coded with the French medical classification for clinical procedures (Classification Commune des Actes Médicaux, CCAM-coding). Each patient has a unique identifier in the PMSI database that allows patient data to be linked between successive hospital stays.

All women with a medical discharge summary that mentions a primary diagnosis of BC (CCAM-codes, Appendix Table-S1) and a mastectomy (Appendix Table-S2) that was performed in 2012 were selected. When two mastectomies were performed, we considered the first one for the analysis.

Medical discharge summaries with error codes in the diagnosis-related groups or in the patient identifier were excluded.

Main endpoint

The studied endpoint was BR, which was identified within the PMSI database using the CCAM-codes listed in Appendix Table-S3. We identified the hospital stays for BRs performed between 2012 and 2015 that were within 3 years of the stay for mastectomy. BR was considered as a binary endpoint (yes/no) for the main analysis and included immediate reconstruction (IR) (i.e., cases in which the mastectomy and BR were listed as procedures during the same hospital stay) and delayed reconstruction (DR) (i.e., cases in which BR was performed at a later hospital stay).

Studied factors

We investigated the impact of several factors on the probability of BR. At the patient level, we considered the patient's age at the time of the mastectomy and the social deprivation index for the area in which they lived. The French geographical deprivation index FDep09 is a socioeconomic ecological indicator that allows for characterization of the socioeconomic level of the population at the municipality level; it is available at https://data.opendatasoft.com/explore/dataset/metropole-indice-de-defavorisation-sociale-fdep-a-lechelle-de-liris-2009-inserm%40public/table/?flg=fr [9,10].

Hospital level predictors included the type and size of the hospital where the mastectomy was performed. We classified hospitals into four categories: university hospitals (UH), private hospitals (Priv.H), public hospitals (Pub.H), and cancer centres (CC). The estimated size of the hospital was computed based on the number of BC surgeries performed in 2012 (primary diagnosis of breast cancer according to ICD-10 and diagnosis-related group of a surgery type). This variable was considered as a categorical variable ([0–50], [50–100], [100–200], [200–500], >500) due to the small number of hospitals with many surgical acts (only six hospitals had more than 1000 procedures).

Lastly, we considered the administrative region of the hospital where the mastectomy was performed. We used the 21 French regions (as defined before 2016) and Corsica for a total of 22 regions. Region level predictors included the density of general surgeons, gynaecologists-obstetricians and plastic surgeons in each region in 2012. The density was computed as the number of surgeons divided by the number of women older than 20 years, which was obtained from the Eco-Santé website (www.ecosante.fr).

Statistical analyses

The main analysis was conducted using all patients eligible for the study that had no missing data for the studied factors.

Age-standardized BR rates, as well as the distribution of predictors at the region level, were mapped using the R cartography and rgdal packages.

A three-level logistic regression analysis was performed using the SAS(R) PROC GLIMMIX procedure (*SAS* Institute, Cary, NC) to model the probability of BR, considering clustering of observations (patients in hospitals, hospitals in regions). Each factor was first studied separately in this hierarchical model using univariate analysis. A multivariable analysis was performed after selecting variables associated with a p-value <.10 from the univariate analysis. The different steps of the modelling are detailed in Appendix-2. The association of each factor with BR rate was quantified by the odds ratio (OR) with its 95% confidence interval (95% CI). The impact of age heterogeneity according to the type of hospital was also evaluated by including an interaction term between age and hospital type, which was represented using a forest plot. For clarity purposes, age was considered as a binary variable (<65 versus >65 years) in this latter analysis. Statistical analyses were performed using SAS enterprise guide software 7.1.

Results

Description of the data

Of the 19,612 women who had a mastectomy due to BC in France in 2012, 19,466 were included in the current study, whereas 146 were excluded due to missing data for the FDep (0.7%). The median age in the study population was 62 years (interquartile range, 50–73; extremes, 17–101). Women aged 65 or over represented 42.7% of the study population (N = 8307). Overall, 5328 (27.4%) of the 19,466 women included in the study had BR: 13.7% (N = 2658) immediate BR and 13.7% (N = 2670) delayed BR.

Impact of age on the breast reconstruction rate

The BR rate varied significantly with age, with a much lower BR rate in older patients than in younger ones (Fig. 1, $p < .0001$). Only 626 of the 8307 patients who were older than 65 (7.5%) had BR compared to 4702 of the 11,159 younger ones (42.1%). In the 5328 patients who had reconstruction, the timing of reconstruction also differed significantly according to age (Fig. 2, $p < .0001$): IR was more frequent than DR in older patients (N = 411, 65.6%, and N = 215, 34.4% respectively), whereas both were relatively balanced in younger ones (N = 2,247, 47.8% and N = 2,455, 52.2%).

The probability of BR decreases after 35 years of age, with a notable decrease in women between 50 and 70 years old (Fig. 1). We observed a non-linear relationship between age and the BR rate, which was very stable in multivariable analysis (see Appendix 2.2).