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Original article

The quality of preoperative diagnostics and surgery and their impact on delays in breast cancer treatment – A population based study

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ABSTRACT

Background and objectives: This study aims to clarify quality of breast cancer surgery in population-based setting. We aim to elucidate factors influencing waiting periods, and to evaluate the effect of hospital volume on surgical treatment policies. Special interest was given to diagnostic and surgical processes and their impact on waiting times.

Methods: All 1307 patients having primary breast cancer surgery at the Helsinki and Uusimaa Hospital District during 2010 were included in this retrospective study.

Results: Median waiting time for primary surgery was 24 days and significantly affected by additional imaging and diagnostic biopsies as well as hospital volume. Final rate of breast conserving surgery was surprisingly low, 51%, not affected by hospital volume, $p = 0.781$. Oncoplastic resection and immediate breast reconstruction (IBR) were performed more often in high volume units, $p < 0.001$. Quality of axillary surgery varied with unit size. Multiple operations, IBR and high volume unit were factors prolonging initiation of adjuvant treatment.

Conclusion: Quality of preoperative diagnostics play a crucial role in minimizing the need of repeated imaging and biopsies as well as multiple operations. Positive impact of high-volume hospitals becomes evident when analyzing procedures requiring advanced surgical techniques. High-volume hospitals achieved better quality in axillary surgery.

Introduction

The aim of breast cancer surgery is to provide excellent oncological outcome without unnecessarily compromising quality of life [1]. Both timely diagnosis and treatment without delay are considered core quality indicators in breast cancer treatment [1,2]. The waiting time for breast cancer surgery has generally increased over the past decade, likely due to increased use of additional imaging modalities and frequent second opinions [3,4]. Furthermore, many surgery-related factors may delay the initiation of adjuvant treatments and thus increase recurrence risk [5–8]. Therefore, describing the process of breast cancer care is important in improving the quality of treatment. Previous studies have identified several factors associated with delays in breast cancer treatment [4,9,10], but organizational factors remain to be evaluated.

The significance of surgical volume on breast cancer survival remains controversial. There are reports [11,12] showing that high surgical volume hospitals are associated with better overall survival and higher breast conserving surgery (BCS) rate [13,14], whereas other studies indicate that the role of surgical volume is not substantial [15,16]. Centralization may provide better facilities for immediate breast reconstructions.

This study aims to clarify quality of breast cancer surgery in a population-based setting. Furthermore, we aim to elucidate factors influencing waiting periods, and to evaluate the effect of hospital volume on surgical treatment policies. Special interest will be given to diagnostic and surgical processes and their impact on waiting times.

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Patients and methods

Patients

All patients having primary breast cancer surgery at the Helsinki and Uusimaa Hospital District during year 2010 were included in this study. Patients were identified from a database. The data was checked and completed with information from electronic patient records. The study plan was approved by the Ethics Committee of Helsinki University Central Hospital.

Database search found 1488 patients of which 181 patients were excluded. Reasons for exclusion were as follows: 49 patients had earlier breast cancer in the same breast, 21 patients had primary breast cancer surgery in 2009, 13 patients had benign breast tumor or risk reducing surgery, 3 patients had other malignant tumor or metastasis in the breast (sarcoma, lung cancer metastasis), 95 patients had corrective breast surgery only, including 61 patients with delayed breast reconstruction. The remaining 1307 patients were included in this study. 23 patients had bilateral breast cancer surgery in 2010 either simultaneously or separately. In these patients, the tumor with more advanced stage was used as index tumor.

Quality indicators

There are no validated and tested quality indicators for breast cancer patients in Finland. The following parameters were modified from EUSOMA recommendation [1] and used as quality indicators:

- Proportion of patients having breast conserving surgery (BCS)
- Proportion of mastectomy patients receiving immediate breast reconstruction (IBR)
- Proportion of oncoplastic resections of all BCS
- Need for re-operation due to insufficient resection margins
- Need for re-operation due to false-negative sentinel node in the intraoperative assessment
- Failure in identifying sentinel node
- Axillary lymph node dissection (ALND) in node negative patients
- Time from referral to surgery
- Time from surgery to adjuvant therapy
- Number of cancer operations.

Population-based screening

Municipal authorities manage breast cancer screening in Finland. Biennial screening is offered to all women aged 50–69 years. According to the Health and Social Services Ministry statistics, screening participation in 2010 was 85% nationally and 79% in the Helsinki and Uusimaa hospital district.

Hospital volume and facilities

Treatment of malignant diseases is almost exclusively performed by public health care system in Finland. Regional health care districts are organizing the treatment. The number of breast cancer operations in each hospital is mainly dependent on the size of the population and incidence of breast cancer within the hospital districts. We do consider this study population-based since patients are referred to certain hospitals based solely on their place of residence. Some special cases, such as those with IBR, are referred to high-volume hospitals performing these operations - hospitals A and B in the present study.

Before referral to hospital for breast cancer surgery, diagnostic imaging and percutaneous needle biopsy are required. During study period indications for pre-operative MRI imaging were:

Table 1
Study population and tumor characteristics.

		All n = 1307	Hospital A n = 697	Hospital B n = 394	Hospital C n = 125	Hospital D n = 57	Hospital E n = 34	p-value
Age, median (range)		62 (22–100)	62 (22–93)	60 (23–100)	62 (31–96)	62 (35–92)	66 (44–89)	0.005
Histological T-stage	Tis&T1mi	97 (7%)	50 (7%)	38 (10%)	5 (4%)	3 (5%)	1 (3%)	<0.001
	T1	813 (62%)	453 (65%)	231 (59%)	77 (62%)	33 (58%)	19 (56%)	
	T2	306 (23%)	157 (22%)	100 (25%)	26 (20%)	16 (28%)	7 (20%)	
	T3-T4	71 (5%)	25 (4%)	20 (5%)	16 (13%)	3 (5%)	7 (20%)	
	N.A.	20 (2%)	12 (2%)	5 (1%)	1 (1%)	2 (4%)	0	
Nodal stage	N0	774 (59%)	420 (60%)	224 (57%)	80 (64%)	33 (57%)	17 (50%)	0.005
	N1mi	82 (6%)	46 (6%)	24 (6%)	4 (3%)	5 (9%)	3 (9%)	
	N1	237 (18%)	118 (17%)	86 (22%)	21 (17%)	4 (7%)	8 (23%)	
	N2, N3	156 (12%)	77 (11%)	44 (11%)	19 (15%)	10 (18%)	6 (18%)	
	N.A.	58 (4%)	36 (5%)	16 (4%)	1 (1%)	5 (9%)	0	
Histological grade	1	306 (24%)	189 (28%)	79 (21%)	21 (17%)	12 (22%)	5 (15%)	0.029
	2	537 (42%)	262 (39%)	175 (45%)	61 (49%)	26 (48%)	13 (38%)	
	3	433 (34%)	228 (33%)	131 (34%)	42 (34%)	16 (30%)	16 (47%)	
ER	positive	1025 (85%)	558 (87%)	306 (86%)	92 (79%)	41 (77%)	28 (85%)	0.070
PR	positive	797 (66%)	431 (67%)	230 (64%)	80 (68%)	33 (62%)	23 (70%)	0.800
HER2	positive	158 (13%)	74 (12%)	47 (13%)	20 (17%)	10 (19%)	7 (21%)	0.173
Histological type	DCIS	96 (7%)	52 (7%)	35 (9%)	5 (4%)	3 (5%)	1 (3%)	0.117
	Ductal	871 (68%)	447 (66%)	274 (70%)	84 (68%)	43 (75%)	23 (69%)	
	Lobular	185 (14%)	98 (14%)	60 (15%)	14 (11%)	7 (12%)	6 (18%)	
	Other Invasive	144 (11%)	92 (13%)	13 (6%)	21 (17%)	4 (7%)	4 (12%)	
Adjuvant treatment	None	94 (7%)	51 (7%)	24 (6%)	12 (10%)	6 (11%)	1 (2%)	<0.001
	Endocrine only	169 (13%)	97 (14%)	38 (10%)	20 (16%)	8 (14%)	6 (18%)	
	Radiotherapy ± endocrine	457 (36%)	261 (37%)	131 (33%)	42 (33%)	18 (32%)	5 (15%)	
	Chemotherapy ± radio ± endo	540 (41%)	265 (38%)	182 (46%)	49 (39%)	22 (38%)	22 (65%)	
	Neoadjuvant treatment	13 (1%)	9 (1%)	2 (1%)	0	2 (3%)	0	
	N.A.	34 (2%)	14 (2%)	17 (4%)	2 (2%)	1 (2%)	0	

ER: oestrogen receptor.
PR: progesterone receptor.
HER2: Human Epidermal Growth Factor Receptor 2.
N.A.: Not available.

Table 2
Patient referral and need of additional hospital diagnostics.

		All n = 1307	Hospital A n = 697	Hospital B n = 394	Hospital C n = 125	Hospital D n = 57	Hospital E n = 34	p-value
Referring institute	Screening	459 (35%)	239 (34%)	145 (38%)	51 (42%)	18 (32%)	6 (18%)	0.132
	Public healthcare	350 (27%)	191 (28%)	95 (24%)	31 (25%)	22 (38%)	11 (32%)	
	Private clinic	487 (38%)	265 (38%)	147 (38%)	41 (33%)	17 (30%)	17 (50%)	
Need of additional hospital diagnostics	None	1054 (81%)	552 (80%)	314 (80%)	117 (94%)	38 (67%)	33 (97%)	<0.001
	MGR, US, core needle biopsy	139 (11%)	80 (11%)	36 (9%)	8 (6%)	14 (25%)	1 (3%)	
	MRI	114 (8%)	65 (9%)	44 (11%)	0	5 (8%)	0	
Surgical biopsy		23 (2%)	8 (1%)	10 (2%)	3 (2%)	1 (1%)	0	0.743

MGR: mammogram.
US: Ultra sound.

invasive lobular carcinoma, recommendation of referring radiologist due to unclear findings in conventional imagining, and breast surgeon's critical assessment. All hospitals performed sentinel lymph node biopsy (SNB) using similar histopathological methods. Nuclear medicine as well as MRI facilities were located in Hospitals A and B.

In this study, oncoplastic resection refers to levels 1 and 2 oncoplastic procedures [17]. The phrase "conventional breast resection" is used when resection of breast tissue is performed with adequate mobilization and closure of tissue to reach best possible aesthetic outcome.

Adjuvant treatment

Systemic adjuvant treatment and radiotherapy were individually planned in multidisciplinary breast cancer team based on patient and disease characteristics according to national guidelines. All study patients receiving adjuvant or neo-adjuvant therapies were referred to a single institute, the Department of Oncology of Helsinki University Hospital.

Statistical methods

The medians of continuous variables were compared using the Mann–Whitney U and Kruskall–Wallis tests and categorical variables were compared using Chi-squared test. Statistical analyses were performed using SPSS version 21 (SPSS Inc., Chicago, IL) statistical software.

Results

Patient and tumor characteristics

Patient and tumor characteristics are displayed in Table 1. More than half of the patients (n = 774, 59%) were node negative with significant difference between hospitals, $p = 0.005$. In hospital E patients were eldest (median 66, range 44–89), with a higher proportion of T3-T4 tumors (20%, $p < 0.001$) and with a higher proportion of grade 3 tumors (47%, $p = 0.029$).

Patient referral and pre-operative examination

Results of patient referral and need of additional hospital diagnostics are provided in Table 2. Use of additional diagnostic imaging and biopsies was significantly different between hospitals, ranging from 33% in hospital D to 3% in hospital E ($p < 0.001$). Markedly, the need of additional diagnostic procedures was different according to referring institute ($p < 0.001$) in both additional conventional diagnostic procedures and pre-operative MRI.

Surgery

Final breast surgery was BCS in 664 (51%) patients, without difference between hospitals ($p = 0.781$). Table 3. Of the 664 patients with BCS as final surgery, 522 (79%) received conventional resection and 142 (21%) oncoplastic resection. Rate of oncoplastic resection varied significantly between hospitals; hospital A was

Table 3
Breast and axillary surgery.

	All n = 1307	Hospital A n = 697	Hospital B n = 394	Hospital C n = 125	Hospital D n = 57	Hospital E n = 34	p-value
Final breast surgery							0.781
BCS	664 (51%)	358 (52%)	198 (51%)	58 (46%)	31 (54%)	19 (56%)	
Oncoplastic resection (% of BCS)	142 (21%)	118 (33%)	16 (8%)	7 (12%)	0	1 (5)	<0.001
Mastectomy	639 (49%)	337 (48%)	194 (49%)	67 (54%)	26 (46%)	15 (44%)	
IBR (% of all mastectomy)	74 (12%)	36 (11%)	38 (20%)	1 (1%)	0	0	<0.001
Final axillary surgery							<0.001
None	45 (3%)	31 (4%)	9 (2%)	0	5 (9%)	0	
SNB	655 (50%)	362 (52%)	189 (48%)	69 (55%)	24 (42%)	11 (32%)	
SNB + ALND	362 (28%)	199 (28%)	122 (31%)	29 (23%)	4 (7%)	8 (24%)	
ALND	207 (16%)	85 (12%)	66 (17%)	26 (21%)	16 (28%)	14 (41%)	
ALND as second operation	38 (3%)	20 (3%)	8 (2%)	1 (1%)	8 (14%)	1 (3%)	
SNB unsuccessful							0.698
	12 (1%)	7 (1%)	2 (1%)	3 (3%)	0	0	
ALND of N0 axilla							0.009
	51 (7%)	19 (5%)	16 (8%)	8 (10%)	4 (14%)	4 (27%)	
Positive SNB, no ALND							
	19 (5%)	14 (6%)	5 (4%)	0	0	0	

BCS: Breast conserving surgery.
SNB: Sentinel node biopsy.
ALND: Axillary lymph node evacuation.
Second operation ALND: ALND due to false-negative sentinel node in intra-operative assessment.
IBR: Immediate breast reconstruction.

Table 4
Number of operations including surgical biopsy and re-operation due to insufficient free tissue margin or false negative intraoperative SNB analysis and complications.

		All n = 1307	Hospital A n = 697	Hospital B n = 394	Hospital C n = 125	Hospital D n = 57	Hospital E n = 34	p-value
Number of cancer operations	1	1143 (88%)	612 (88%)	337 (85%)	117 (93%)	46 (82%)	31 (91%)	0.051
	2	151 (11%)	78 (11%)	55 (14%)	6 (5%)	10 (18%)	2 (6%)	
	3	9 (1%)	4 (1%)	2 (1%)	2 (2%)	0	1 (3%)	
Re-operation due to insufficient free tissue margin		99 (8%)	49 (7%)	39 (10%)	5 (4%)	3 (5%)	3 (9%)	0.190
Type of re-operation after insufficient margin	Resection	22 (22%)	5 (10%)	14 (36%)	0	2 (67%)	1 (33%)	0.059
	Mastectomy	49 (50%)	30 (61%)	12 (31%)	4 (80%)	1 (33%)	2 (67%)	
	Mastectomy + IBR	28 (28%)	14 (29%)	13 (33%)	1 (20%)	0	0	
Surgical complication demanding re-operation	None	1243 (95%)	667 (96%)	371 (94%)	121 (97%)	55 (97%)	29 (85%)	
	Hematoma	45 (3%)	16 (2%)	18 (5%)	4 (3%)	2 (4%)	5 (15%)	0.002
	Wound healing problem	17 (1%)	13 (2%)	4 (1%)	0	0	0	0.306

IBR: Immediate breast reconstruction.

clearly performing more oncoplastic surgery than others, $p < 0.001$. Of 639 (49%) patients receiving mastectomy, IBR was performed in 74 (12%) patients. Between two high-volume centers (A and B), there was a significant difference in IBR rate, $p = 0.004$.

Altogether 1259 (96%) patients underwent axillary surgery (Table 3). SNB was unsuccessful in 12 (1%) cases and 9 (75%) of these patients received ALND, with no difference between hospitals ($p = 0.698$). Altogether 51 node negative patients underwent ALND, comprising of 7% of all node negative patients with significant difference between hospitals, $p = 0.009$. Six of these 51 patients with upfront ALND received neo-adjuvant treatment and were node negative in post-operative pathological assessment. There was 19 patients with positive sentinel nodes (5% of all patients with positive SNB) who received no ALND. In 38 (10% of all ALND after SNB) cases ALND was performed as a second operation due to false negative result in the intraoperative assessment of sentinel nodes with a significant difference between hospitals, $p < 0.001$.

Complications demanding surgical intervention were rare, 1243 (95%) patients had none. Post-operative hematoma was the most common complication: 45 (3%) patients underwent hematoma evacuation, with a significant difference between hospitals ($p = 0.002$). Table 4.

Number of cancer operations

Of all patients, 1143 (88%) had only one cancer operation (Table 4). Of those 160 patients receiving additional cancer operations 151 (11%) received two operations and 9 (1%) three operations with borderline significant difference between hospitals, $p = 0.051$. Re-operation rate due to insufficient tumor-free tissue margin was 7.6% (99 patients). The re-operation was mastectomy in 77 (78%) patients, with marginally significant difference between the hospitals ($p = 0.059$). After secondary mastectomy 28 patients (28%) received IBR, which is more often than after primary mastectomy (46 patients, 9%), $p < 0.001$.

Waiting time

Waiting times from referral to primary surgery and from primary surgery to initiation of any adjuvant treatment are shown in Table 5. Waiting time for radiation therapy is shown for patients who did not receive chemotherapy. In this group endocrine therapy may have been started before radiation. Patients receiving neo-adjuvant treatment (n = 13) were excluded from the waiting time analysis.

Median waiting time from referral to primary surgery was 24 days (1–188), Table 5a. Low volume hospitals C and E provided primary surgery significantly faster, $p < 0.001$ between hospitals. Additional biopsies, pre-operative MRI and IBR increased median wait time significantly, Table 5b. Reasons for primary surgery delayed over 28 days were analyzed, see Table 6. 1166 (89%) patients received adjuvant treatments. Median waiting time from primary operation to initiation of any adjuvant treatment was 47 days (8–112) and significantly differed between hospitals ($p = 0.005$) (Table 5a). Wait times for initiation of adjuvant treatment were significantly affected by type of primary surgery and number of cancer operations, Table 5c. In eight patients, the delayed adjuvant treatment was due to complications requiring surgical intervention.

Table 5a
Median waiting times (days).

		All	Hospital A	Hospital B	Hospital C	Hospital D	Hospital E	P-value
From referral to primary surgery N = 1110	median (min–max)	24 (1–188)	26 (6–188)	27 (4–142)	19 (1–153)	19 (7–96)	15 (6–37)	<0.001
From primary surgery to initiation of any adjuvant treatment N = 1148	median (min–max)	47 (8–112)	47 (14–95)	48 (9–112)	43 (8–82)	50 (29–83)	44 (19–70)	0.005
From primary surgery to initiation of systemic adjuvant treatment N = 698	median (min–max)	47 (8–95)	48 (14–95)	48 (9–83)	42 (8–82)	50 (29–71)	42 (19–70)	0.126
From primary surgery to initiation of chemotherapy N = 536	median (min–max)	48 (11–95)	48 (24–95)	49 (23–83)	45 (11–82)	50 (31–71)	49 (28–70)	0.834
From primary surgery to initiation of endocrine therapy N = 162 *	median (min–max)	41 (8–90)	43 (14–90)	43 (9–79)	40 (8–46)	48 (29–56)	26 (19–55)	0.024
From primary surgery to radiotherapy N = 264 *	median (min–max)	55 (26–125)	55 (26–113)	57 (31–125)	55 (35–77)	55 (41–99)	56 (47–63)	0.216

*Only patients not receiving chemotherapy included.

Table 5b
Waiting times for surgery.

		Wait time for surgery, days median (range)	p-value
Additional biopsy	yes	37 (22–153)	<0.001
	no	23 (1–188)	
Pre-operative MRI	yes	34 (22–146)	<0.001
	no	23 (1–188)	
Type of surgery	Conventional resection	23 (1–161)	0.146
	Oncoplastic resection	25 (8–126)	
	Mastectomy without IBR	25 (4–188)	0.002
	Mastectomy with IBR	30 (7–84)	

Table 5c
Waiting times for adjuvant treatment.

	Wait time from primary surgery to adjuvant treatment days, median (range)				p-value
Type of surgery	Conventional resection	Oncoplastic resection	Mastectomy	IBR	0.011*
	47 (8–112)	48 (19–90)	46 (11–95)	54 (30–83)	
Number of cancer operations**	1	2	3		<0.001
	49 (5–120)	57 (26–125)	85 (56–90)		

*Between mastectomy and IBR.
**Only patients receiving chemotherapy and/or radiation.

Discussion

Study population

This study investigates breast cancer care in a true population-based setting. Many previous studies are based on selected population, registries or single-institution data [3,9,14,18] or have exclusions altering the study population [16]. However, the proportion of DCIS in our study population was rather low, 7%, when compared with the 10% prevalence of DCIS in Finnish Cancer Registry Our study design does not explain this difference. As regards to differences in patient populations between the hospitals, patients in hospital E were older than in other hospitals. This may explain the slightly lower proportion of screen detected cancers and the higher proportion of grade 3 and node positive tumors in Hospital E.

Indeed, A and B are high-volume hospitals, but these hospitals receive patients from the Helsinki metropolitan area. The populations of hospitals C, D and E areas are more rural-like where patients' values may be different. Moreover, hospital B had the youngest patients (median age 60 years) and E having the oldest patients (median age 66 years), corresponding to IBR rates of 20% and 0%, respectively.

Waiting time for surgery

The need for additional diagnostics, including biopsies as well as MRI caused delay in surgical treatment, as has been suggested also in previous studies [4,19]. Patients referred by private clinics had significantly more additional diagnostic procedures, possibly reflecting differences in patient characteristics but also in clinical practice and expertise. The use of additional diagnostic procedures differed significantly between hospitals, with no plausible explanation from differences in population or tumor characteristics. This variance may arise from organizational or clinical practice differences that are not readily displayed by the available data. These differences are placing patients in unequal situation, since use of additional biopsies increases waiting time to primary surgery. Further work needs to be done to standardize these assessments.

Breast surgery

Overall rate of BCS was surprisingly low, 51%. There was no correlation between hospital volume and BCS rate. Earlier studies have demonstrated higher BCS rates in selected populations [2,3,13], but a previous Finnish study by Peltoniemi et al. [14] and BCCOM project [20] from UK reported similar BCS rates as observed in the present study. In Finland neo-adjuvant systemic therapy is not frequently used to downsize the tumor to enable BCS. However, the BCS rate has continuously increased since 2010, being almost 70% in 2014. Increase in BCS is probably due to accepting less extensive free tissues margins after BCS as well as increase of the proportion of patients treated by oncoplastic BCS, instead of mastectomy.

In order to provide the best possible aesthetic outcome, advanced oncoplastic and reconstructive techniques are often

Table 6
Number of patients waiting for primary surgery (over 28 days) and for adjuvant therapy (over 56 days) and reasons for long waiting times.

		All	Hospital A	Hospital B	Hospital C	Hospital D	Hospital E	P-value
Primary surgery over 28days, reason N = 451	Imaging/biopsy	152 (34%)	86 (33%)	55 (35%)	3 (19%)	7 (70%)	1 (17%)	<0.001
	co-morbidity	3 (1%)	2 (1%)	0	1 (6%)	0	0	
	Patient related	7 (2%)	6 (2%)	1 (1%)	0	0	0	
	Open biopsy first	5 (1%)	0	3 (2%)	2 (13%)	0	0	
	Long waiting list	284 (63%)	169 (64%)	97 (62%)	10 (63%)	3 (30%)	5 (83%)	
Adjuvant therapy over 56 days, reason N = 210	Re-operation	62 (30%)	33 (27%)	19 (31%)	4 (40%)	6 (55%)	0	0.092
	Complication	8 (4%)	1 (1%)	4 (7%)	2 (20%)	0	1 (17%)	
	Co-morbidity	3 (1%)	3 (3%)	0	0	0	0	
	Patient related	2 (1%)	1 (1%)	1 (2)	0	0	0	
	Long waiting list	135 (64%)	84 (69%)	37 (60%)	4 (40%)	5 (45%)	5 (83%)	

needed [22,23]. Positive impact of high-volume and treatment centralization was seen in oncoplastic resection; most (83%) were performed in hospital A with the largest volume. These techniques were rather new in Finland during study period and were truly adopted only by specialized breast surgeons. This audit study clearly indicates that continuous education is needed to adopt latest techniques and guidelines also in smaller hospitals. Therefore surgeons from smaller hospitals work periodically in hospital A and also participate regularly international and national courses and congresses to update their knowledge.

Re-excision rate due to insufficient resection margins was very low, less than 8%. It is clearly lower than in previous studies reporting approximately 17–26% re-excision rates [21,28,29]. On the other hand, mastectomy rate was high, which may partly explain the low re-operation rate. Notably, almost 80% of the re-operation were mastectomies, even though oncological safety of multiple excisions has been demonstrated earlier [30] and secondary mastectomy rates reported earlier are clearly lower [21,29]. However, multiple resections lead often to a less favorable aesthetic outcome after BCS [31].

Axillary surgery

SNB procedure seems to be of high quality with proportion of unsuccessful SNB as low as about 1% and rate of ALND of node negative axillae acceptable. However, in low-volume hospitals quality of axillary surgery did not reach the same level. During last decade indications for SNB have been expanding rapidly [24–27]. High-volume academic centers may have adopted the expanded indications of SNB faster than the smaller hospitals.

Waiting times for adjuvant treatment

In agreement with earlier studies, our results indicate that multiple cancer operations as well as IBR are causing delay in initiation of adjuvant treatment [7]. Delays of adjuvant treatment are associated with worse breast cancer outcomes [5,8,32], while no consensus exists on the optimal time interval between surgery and adjuvant treatment. In previous retrospective analyses, four weeks of delay in postoperative radiotherapy increases locoregional recurrences by 11% [8]. Additionally, four weeks of delay in adjuvant systemic therapies increases the risk for recurrence by 16% and mortality by 15% [6]. High quality of diagnostics and surgery together with adequate resourcing of surgical and adjuvant treatment are demanded to ensure timely breast cancer care. The role of surgical complications in delaying adjuvant treatments could not be clarified properly, since our data includes only complications that required surgical treatment.

Limitations

This study has limitations. We were focusing on factors affecting quality of breast cancer surgery and their impact on waiting times, but not their impact on survival and quality of life. Our findings are neither generalizable in units with a different case-mix. This study underlines the need of quality database, since data abstraction and integration from multiple sources required a significant investment of time and expertise, thus also delaying publication of our results. Integrating fragmented data is also prone to potential coding errors and missing information. The rather low number of patients from hospitals D and E is prone to generate coincidental statistical results. For example, the high number of hematomas in the smallest hospital E may represent such a coincidental finding. Moreover, complications were reported only if surgical intervention was required.

Conclusion

When aiming at timely high-quality breast cancer treatment, preoperative diagnostics play a crucial role in minimizing the need for repeated imaging and biopsies. Multiple cancer operations and immediate breast reconstruction caused delays in initiation of adjuvant treatment. Positive impact of high-volume hospitals becomes evident when analyzing procedures requiring advanced surgical techniques like oncoplastic and reconstructive breast surgery. Moreover, high-volume hospitals also achieved better quality in axillary surgery.

Conflict of interest statement

Authors have no commercial interest in this study.

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