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Rationalizing blood transfusion in elective breast cancer surgery: Analyzing justification and economy

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Abstract:

BACKGROUND: Transfusion of allogeneic blood in breast cancer surgery is variable, and differences of transfusion incidence have been observed in the literature. Most hospital guidelines including ours dictate group and reserve policy of blood before breast surgery. Here, we aimed to audit the blood utilization in patients undergoing elective breast surgery in our hospital and thereby optimize the blood ordering schedule, economic burden, and loss of clinical resources.

MATERIALS AND METHODS: The study included 478 breast cancer surgeries over a period of 6 years. Patient and disease details were obtained from patient file and hospital information system. Blood samples sent to blood bank were subjected to compatibility test and reserved. All transfusions were documented, and statistical analysis was done.

RESULTS: Of the total 478 patients, most underwent wide local excision of the breast and modified radical mastectomy. A total of 16 patients received 71 units of blood and blood components in all categories of surgeries. Only 103 were younger women (≤ 40 years), with a mean age of 31 years. Nontransfused patients were significantly more than transfused ones ($P < 0.05$). Frequency of blood transfusion was more in young patients (4.9%). Seven (22.6%) of the total 31 Stage IV patients received blood transfusions. Frequency of blood transfusion was more in patients undergoing surgery after chemotherapy (8.8%). A significant loss of time and loss of revenue was observed.

CONCLUSION: We conclude that routine compatibility test is not justified for all patients undergoing breast surgery. A more targeted approach is needed to reduce blood demand and associated cost to patient and blood transfusion services.

Keywords:

Blood transfusion, breast cancer, breast surgery, mastectomy, wide local excision

Introduction

Reduction of immune responsiveness through blood transfusion has been documented by previous authors.^[1-3] Clinical data revealed an increased incidence of malignancy in patients with deficient or compromised immune system.^[4-6] Investigators in the recent past depicted promoting the effect of allogeneic blood transfusion on experimental tumor growth.^[7-9] Breast cancer is considered as

one of the most common cancer globally and the second main cause of death in females.^[10] Transfusion of allogeneic blood in breast cancer surgery is variable, and differences of transfusion incidence have been observed in the literature.^[11-14] Most maximum surgical blood ordering schedule (MSBOS) dictates crossmatching and reservation of blood, particularly packed red blood cell (PRBC) units before surgery.^[15,16] However, factors deciding requirement of transfusion in breast surgery are numerous and importantly include patient age, cancer stage, estrogen receptor (ER) status, menopausal status, chemotherapy, and surgical skill.^[1] As per our hospital protocol,

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every patient planned for elective breast cancer surgery should routinely have a blood sample sent for reservation of one unit of compatible PRBC in the blood bank. In this study, we aimed to audit the blood utilization in patients undergoing elective breast surgery and thereby optimize the blood ordering schedule, economic burden, and loss of clinical resources.

Materials and Methods

The prospective study included 478 breast cancer patients who were histopathologically confirmed and planned for elective breast surgeries from January 2011 to December 2016. All surgeries were performed by the same surgical specialist. Patient and disease details that included age, stage, TNM status, ER and progesterone receptor (PR) status, human epidermal growth factor receptor 2 (HER-2) expression, triple-negative breast cancer (TNBC) status, and reproductive and treatment status were obtained from patient file and hospital information system. Patients were divided into two groups: younger group (≤ 40 years) and older group (>40 years). ER and PR were considered negative when their concentration was detected below 10%. HER-2/neu expression was considered positive when complete membrane staining was seen in $>10\%$ tumor cells. Blood samples for blood grouping and crossmatching were sent to blood bank for mandatory compatibility test and blood reservation before surgery. All compatibility tests were performed using the automated column agglutination technology (CAT) (Ortho Diagnostics, Johnson and Johnson, USA). Details of test, blood issue, and blood transfusion were documented in the blood bank. All transfusions were subjected to hemovigilance, and any adverse events observed during or after blood transfusion were investigated and documented. The study tried to justify the economy with regard to approximate loss of time in terms of minutes and wastage of resources in terms of money (INR) in the blood bank. Loss of time was calculated from receipt of patient samples and requisition to storing compatible blood units for future transfusion. Wastage of resources was estimated on the use of reagents, CAT cards, panel cells for compatibility testing, and use of miscellaneous major items such as gloves, pipette tips, test tubes, electricity, and storage facility.

Statistical analysis was done using the SPSS statistical package (IBM, SPSS, Version 13, USA). All results were calculated as a mean \pm standard deviation and $P < 0.05$ was considered statistically significant.

Results

Table 1 depicts blood transfusion in various categories of surgeries in breast cancer patients. Of the total 478 patients, most underwent wide local excision of the breast (36.6%) and modified radical mastectomy (30.1%). Fifty-one patients (10.7%) underwent wide excision of breast with oncoplastic reconstruction. A total of 16 (3.3%) patients received 71 units of blood and blood components that included 34 units of PRBC (2.1 units/patient), 29 units of fresh frozen plasma (FFP) (1.8 units/patient), and 8 units of platelet concentrates (0.5 units/patient), with perioperative transfusion of 59 (83.1%) blood units. Blood transfusion was needed in all categories of surgeries and 4 (25%) of the 16 transfused patients belonged to the modified radical mastectomy group.

Table 2 describes the patient and disease characters in relation to transfused and nontransfused groups. Of the 478 patients, only 103 (21.5%) were younger women (≤ 40 years), with a mean age of 31 years. While incidence of T2N2M0 was more under the TNM classification, 273 (57.1%) patients belong to Stage III. Positive ER and PR were observed in 52.1% and 67.6% patients, respectively. TNBC was observed in 103 (21.5%) patients. Where only 144 (30.1%) patients were in the premenopausal stage, patients who underwent surgery after chemotherapy were 102 (21.3%). In relation to patient and disease characters, a number of nontransfused patients were significantly more than transfused ones ($P < 0.05$). Frequency of blood transfusion was more in younger (4.9%) than older patients (2.9%). Seven (22.6%) of the total 31 Stage IV patients received blood transfusions. Considering transfusions in the positive or negative categories of ER or PR or HER-2 status, both categories received blood transfusions, and the difference was not statistically significant. Frequency of blood transfusion was more in patients undergoing surgery after chemotherapy (8.8%)

Table 1: Blood transfusion and surgical procedures in breast cancer patients (n=478)

Type of Surgery	Patients underwent surgery n (%)	Transfused patients n (%)	No. of blood component units transfused			
			PRBC	FFP	Platelets	Total blood components
Wide local excision	175 (36.6)	3 (18.7)	4	3	0	7
Modified radical Mastectomy	144 (30.1)	4 (25)	7	4	0	11
Simple mastectomy and axillary clearance	91 (19)	2 (12.5)	5	8	0	13
Revision Mastectomy	8 (1.7)	2 (12.5)	8	7	0	15
Mastectomy with Latissimusdorsi reconstruction	9 (1.9)	2 (12.5)	5	3	4	12
Wide excision with oncoplastic reconstruction	51 (10.7)	3 (18.7)	5	4	4	13
Total (n)	478	16	34	29	8	71

Table 2: Patient character, Disease character and Blood transfusion in breast cancer surgery (n=478)

Patient and disease characters	No. of patients n (%)	Transfused patients n (%)	Non-transfused patients n (%)	P
Age (years)				
≤40	103 (21.5)	5 (4.9)	98 (95.1)	0.007
>40	375 (78.5)	11 (2.9)	364 (97.1)	0.005
TNM classification				
T				
1	98 (20.5)	1 (1.02)	97 (99)	0.003
2	157 (32.8)	3 (1.9)	154 (98.1)	0.004
3	119 (24.9)	7 (5.9)	112 (94.1)	0.013
4	104 (21.8)	5 (4.8)	99 (95.2)	0.011
N				
0	32 (6.7)	2 (6.3)	30 (93.7)	0.012
1	123 (25.7)	3 (2.4)	120 (97.6)	0.005
2	167 (35)	4 (2.4)	163 (97.6)	0.005
3	156 (32.6)	7 (4.5)	149 (95.5)	0.010
M				
0	434 (90.8)	10 (2.3)	424 (97.7)	0.006
1	44 (9.2)	6 (13.6)	38 (86.4)	0.032
Stage				
I	23 (4.8)	1 (4.3)	22 (95.7)	0.014
II	151 (31.6)	2 (1.3)	149 (98.7)	0.009
III	273 (57.1)	6 (2.2)	267 (97.8)	0.007
IV	31 (6.5)	7 (22.6)	24 (77.4)	0.039
Estrogen receptor status				
Positive	249 (52.1)	9 (3.6)	240 (96.4)	0.012
Negative	229 (47.9)	8 (3.5)	221 (96.5)	0.023
Progesterone receptor status				
Positive	323 (67.6)	10 (3.1)	313 (96.9)	0.010
Negative	155 (32.4)	6 (3.9)	149 (96.1)	0.017
HER - 2 status				
Positive	396 (82.8)	7 (1.8)	389 (98.2)	0.008
Negative	82 (17.2)	9 (11)	73 (89)	0.026
TNBC	103 (21.5)	6 (5.8)	97 (94.2)	0.032
Reproductive status				
Premenopausal	144 (30.1)	7 (4.9)	137 (95.1)	0.012
Postmenopausal	334 (69.9)	9 (2.7)	325 (97.3)	0.008
Treatment status				
Surgery after chemotherapy	102 (21.3)	9 (8.8)	93 (91.2)	0.036
Surgery before chemotherapy	376 (78.7)	7 (1.9)	369 (98.1)	0.007

ER=Estrogen receptor, RP=Progesterone receptor, TNBC=Triple negative breast cancer

compared to patients who underwent surgery before chemotherapy (1.9%) ($P = 0.032$). Justifying the loss of time and wastage of resources for those PRBC units which were reserved but not transfused, the total time and economy losses per unit were estimated to be 105 min and INR 550, respectively. Considering 462 reserved but nontransfused PRBC units, the total estimated time and economy losses were 48,510 min (33.68 days) and INR 254,100 respectively.

Discussion

With the development of health-care facility and surgical skill, blood transfusion in breast cancer surgery is almost negligible. Moreover, immunomodulation and

immune system disturbances due to blood transfusion have already been documented in the literature.^[1] Still, crossmatch and reserve policy are popularly practiced in breast cancer surgery. Many authors discouraged this practice as it led to the inefficient utilization of resources, cost, and unnecessary workload for blood bank.^[11,15] The current study demonstrated crossmatch and reserve policy for all 478 patients as dictated by the hospital MSBOS for breast cancer surgery. Blood transfusion was needed in 3.1% patients who needed one or other blood components.

Malik *et al.* in their audit observed that blood samples were sent to blood bank for group and save in 438 patients (88.1%); however, only 19 (3.82%) patients

received blood transfusions, of which 10 patients underwent breast reconstructive procedure.^[15] The current study demonstrated that patients undergoing revision mastectomy and mastectomy with reconstruction (4 of 17, 23.5%) are more likely to be associated with perioperative or postoperative transfusions. However, patient who underwent wide local excision of breast, simple mastectomy with axillary clearance, and radical mastectomy needed the least transfusions ranging from 1.7% to 2.7%.

While Al-Benna and Rajgarhia observed 0% perioperative and 8% postoperative transfusions, Prichard *et al.* depicted 5 of 229 patients (2.1%) receiving blood transfusions. Both the studies observed a high crossmatch to transfusion (CT) ratio, and authors concluded that the group and save method was not justified, leading to significant wastage of clinical resources.^[11,12] We observed that 621 units of PRBC were crossmatched for 478 patients, of which 34 units were transfused, and this resulted in a CT ratio of 18:1. This necessitates revision of the existing MSBOS and developing a blood ordering protocol which can optimize blood utilization efficiency. Platelets and FFP were transfused in 8 and 2 patients, respectively, and transfusions were found to be justified in relation to deranged coagulation and platelets.

The older studies described the higher frequency of blood transfusions in breast surgeries. Where Hoe *et al.* in a study between 1960 and 1979 observed a transfusion frequency of 8.4% in their 455 patients, for Eickhoff *et al.* in 1991, the frequency was 14.3% in a study population of 96 patients.^[13,14]

The present study described the need for blood transfusion with regard to disease and patient characters in breast cancer surgery [Table 2]. A significant difference between a number of transfused and nontransfused patients were observed under any of the parameters describing the patient and disease characters. Among the transfused patients, there were no significant differences considering the patient age, TNM stage, ER or PR or HER-2 status, and menopausal status. Voogt *et al.* in a study between 1973 and 1977 demonstrated 70% patients of invasive breast cancer receiving blood transfusion. Except preoperative anemia, the authors found no parameters that determined the need of blood transfusion.^[1]

Older patient population undergoing surgery was significantly higher than younger population ($P = 0.013$) with most patients with Stage II and III diseases compared to Stage I and IV ($P < 0.03$). Where PR and HER-2 positive patients were significantly higher than their negative counterpart, premenopausal patients (30.1%)

were lower than postmenopausal ones ($P < 0.01$). The requirement of blood transfusion was more in patients who underwent surgery after chemotherapy. Nine out of 102 such patients (8.8%) required transfusions which was significantly higher ($P = 0.032$) than patients who underwent surgery before chemotherapy (1.9%).

Pourzand *et al.* observed a higher incidence of Stage II and Stage III (82.8%) in their patient population with tumor characteristics significantly different in younger woman compared to older group. Only 17.1% of their patients were younger with most having positive lymph node (77.7%). Studying the tumor characteristics of the present population, the findings are almost similar to those demonstrated by Pourzand *et al.*^[10]

Detailed clinical evaluation of a patient before planning a breast surgery is very essential for assessing blood requirement. This will prevent the additional burden on the blood bank, hospital, and patient as far the losses of time and economy are concerned. Where a total loss of time and loss of revenue in the present study were estimated to be 48,510 min and INR 254,100, respectively, Malik *et al.* calculated a loss of £1913.89 in their study. They concluded that, in elective breast cancer surgery, preoperative blood group and save policy appeared to be an unnecessary procedure and only add to the burden on patients and laboratories.^[15] We observed that a significant time and revenue can be saved if the compatibility testing and reservation policy are applied in patients needing blood transfusions.

Conclusion

We conclude that the likelihood of perioperative blood transfusion is more in certain types of breast surgery; however, overall transfusion in breast surgeries is rare. For all patients, the routine compatibility test is not justified, and such practice leads to significant loss of time, manpower, and clinical resources. Since no patient or disease parameter singly or collectively dictates the necessity of blood transfusion, therefore, a more targeted approach is needed to reduce blood demand and associated cost to patient and blood transfusion services.

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Conflicts of interest

There are no conflicts of interest.

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