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Original Article

Pathology Section

Association of ABO Blood Group Status in Patients with Breast Lesions and Emphasis on Invasive Breast Carcinoma

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ABSTRACT

Introduction: The ABO blood group antigens are expressed on the erythrocyte membrane and on the surface of other normal and pathological cells. Recently, there has been an increasing research interest in the association between ABO blood group antigens and certain type of human cancers.

Aim: To determine the association of ABO blood group and Rh blood type in patients with breast lesions.

Materials and Methods: It was a retrospective observational study done at a rural tertiary care referral institute, PES Institute of Medical Sciences and Research (PESIMSR), Kuppam, Andhra Pradesh, India, from January 2015 to December 2018. Apparently healthy female voluntary blood donors constituted the control group (n=222). Patients with breast lesions constituted the study group (n=125). The association of the breast lesions with ABO blood group and Rh blood type was analysed. Frequencies, Chi-square test and crosstabs were the statistical tools used for data analysis. All the statistical calculations were performed through Statistical Software for Data Science (STATA) version 14.1.

Results: Total 125 cases of breast lesions were analysed. Neoplastic lesions 113 (90.4%) were more common than the non neoplastic lesions 12 (9.6%). Blood group "O" was the most common blood group in malignant neoplasms and was statistically significant (p=0.045). Blood group B was the most common blood group in grade II invasive breast carcinoma and was statistically just significant (p=0.05).

Conclusion: A definite change in the pattern of distribution of ABO blood group was observed in grade II malignant neoplasms. It may be hypothesised that knowing the blood group of breast cancer patients may be beneficial in order to triage the patients for the purpose of efficient management.

Keywords: Antigens, Donors, Erythrocyte, Neoplasms

INTRODUCTION

The ABO and Rhesus (Rh) blood groups are the major blood groups systems with paramount importance in transfusion medicine [1]. The ABO blood group antigens are expressed on the erythrocyte membrane and on the surface of other normal and pathological cells. Recently, there has been an increasing research interest in the association between the ABO blood group antigens and certain type of human cancers, particularly the gastric and pancreatic cancers [2].

Breast cancer is considered as a major public health problem [3]. Breast cancer is the most common cancer among urban Indian females and the second common cancer in rural India [4]. The ABO blood group system may play a role in etiopathogenesis of the disease also [5]. Rh negative patients were more likely to develop metastasis following breast cancer [2]. However, the available data for an association of ABO blood group system with breast cancer are inconsistent and controversial [3]. Furthermore, only few studies have focused on the histological grades of the breast cancer [2,6,7]. Not only the association of breast cancer with blood groups was analysed, but also the association of blood groups with grades of malignant neoplasms were determined in the present study.

The present study was undertaken to compare the pattern of distribution of ABO and Rh blood group status in patients with various breast lesions with that of the apparently healthy female voluntary blood donors.

MATERIALS AND METHODS

A retrospective observational study was conducted in the histopathology section and blood bank section in the Department of Pathology at a rural tertiary care referral institute, PESIMSR, Kuppam, Andhra Pradesh, India. The study included cases documented from January 2015 to December 2018. The histopathology slides of all the cases were retrieved and reviewed from May 2019 to July 2019 for a total period of three months. The study was approved by the Institutional Ethics Committee (Bearing number PESIMSR/IHEC/47).

Sample size calculation: The sample size was calculated by using following formula:

$$n = \frac{\{Z_{1-\alpha/2} + Z_{1-\beta}\}^2 \times [P_1(1-P_1) + (1-P_2)]}{(P_1-P_2)^2}$$

n is the sample size in each group

p_1 is the expected proportion of control samples

p_2 is the expected proportion of study samples

$\alpha = 0.05$ (two-sided)

$\beta = 0.20$

$Z_{1-\alpha/2}$ is the value of the standard distribution corresponding to level of significance at 5% that is 95% confidence interval

$Z_{1-\beta}$ is the value of the standard distribution corresponding to the desired level of power (80%).

Inclusion and Exclusion criteria: All cases of breast lesions diagnosed by histopathological examination were included in the study. Those cases in which biopsy specimens was unsatisfactory (inadequate, haemorrhagic and non diagnostic specimens) for evaluation were excluded from the study. Those cases in which the patients' ABO blood group and Rh blood type data was not available were also excluded from the study.

Study Procedure

A total of 125 cases were analysed. The study population constituted female patients with breast lesions. All breast lesions were categorised into malignant lesions and non malignant (benign) lesions. All neoplastic lesions of the breast were categorised according to WHO classification of tumours of breast 4th edition (2012) [8]. All

malignant lesions were further categorised into histological grades (based on Nottingham histologic score). ABO blood group, Rh blood type and other clinical details were retrieved from the request forms and case records. The distribution of ABO blood type and Rh blood type of these breast lesions were compared with that of the control group. A total of 222 apparently healthy female voluntary blood donors constituted the control group. The control group which included apparently healthy voluntary female donors were selected by routinely screening procedure which included donor selection criteria questionnaire, physical examination and basic haematological investigation such as haemoglobin estimation to rule out anaemia. The association between the blood group and breast lesions was determined by statistical methods.

STATISTICAL ANALYSIS

All the statistical calculations were performed through statistical software STATA version 14.1. The socio-demographic variables and descriptive statistics were represented using frequencies and percentages. Chi-square test or fischer-exact test for categorical variables was used. All results were analysed by considering statistical significance at a level of p-value less than 0.05.

RESULTS

In the present study, 125 cases of breast lesions were analysed. The lesions were seen in females in the range of 13-80 years. Clustering of cases of breast lesions was seen in the fifth decade (mean=38.87 years). Neoplastic lesions were common in the fifth decade (mean=39.27 years). Non neoplastic lesions were common in the third and fourth decade (mean=35.08 years). Benign neoplasms were common in the third decade (mean=30.17 years). Malignant neoplasms were common in the fifth decade (mean=49.58 years).

In the control group (n=222 cases), their ages ranged from 18-57 years. Majority of apparently healthy voluntary female donors were in the second decade (mean=22.32 years) of life.

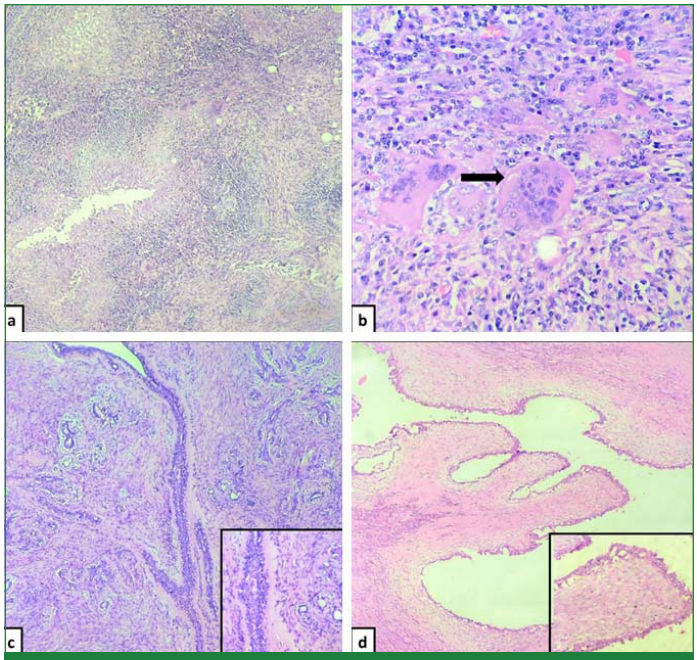
Breast lesions were more common in the right breast 63 (50.4%) than the left breast 56 (44.8%). Upper outer quadrant 40 (32%) was the most common site of involvement of breast lesions. Right breast was more frequently involved in neoplastic lesions 59 (52.21%). Right breast was more frequently involved in both the benign 31 (51.67%) and the malignant neoplasms 28 (52.83%). In contrast, left breast was more frequently involved in non neoplastic lesions 8 (66.67%).

Among 125 cases of breast lesions, neoplastic lesions were more common than the non neoplastic lesions. Among non neoplastic lesions, inflammatory lesion was the most common lesion 9 (7.2%), accessary breast tissue 2 (1.6%) and cystic lesion 1 (0.8%) [Table/Fig-1a,b]. Among neoplastic lesions, benign neoplasms were more common than the malignant neoplasms. Most common benign neoplasm was fibroadenoma 57 (45.6%), followed by phyllodes tumour 3 (2.4%) [Table/Fig-1c,d]. Most common malignant neoplasm was invasive breast carcinoma of No Special Type (NST), followed by carcinoma with medullary features 5 (4%) [Table/Fig-2a-d]. Invasive lobular carcinoma 2 (1.6%) mucinous carcinoma 1 (0.8%), invasive micropapillary carcinoma 1 (0.8%), inflammatory carcinoma 1 (0.8%) and invasive papillary carcinoma 1 (0.8%) [Table/Fig-3a-d,4].

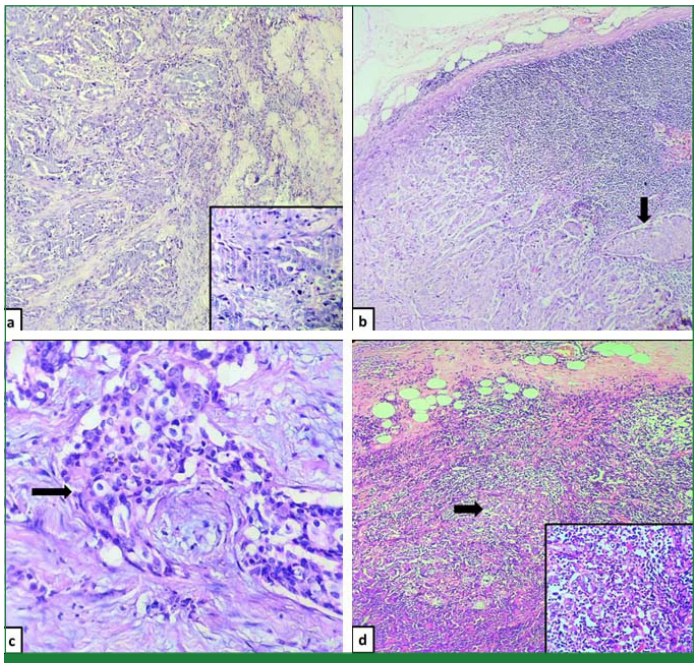
The invasive breast carcinoma was further categorised into grade I, grade II and grade III lesions based on Nottingham histologic score. The grade II category 35 (66.04%) constituted the most common malignant neoplasms followed by grade I 11 (20.75%) and grade III 7 (13.21%).

The pattern of distribution of ABO blood groups of different categories of breast lesions were compared with the pattern of distribution of ABO blood groups in the control group. The O blood group was the most common blood group in the control population followed by B blood group, A blood group and AB blood group. The O blood group was the most common blood group in all the categories. The non malignant lesions category included benign neoplasms and non neoplastic lesions of the breast. The pattern of distribution constituted O blood group as the most common blood group, followed by B, A and AB blood groups in the decreasing order of the frequency. The benign neoplasms, non malignant lesions and non neoplastic lesions, showed a change in the pattern of distribution. A blood group was more frequent than B blood group in benign neoplasms and non malignant lesions. AB blood group was more frequent than A blood group in non neoplastic lesions. But, the pattern of distribution in benign neoplasms, non malignant lesions and non neoplastic lesions was not statistically significant [Table/Fig-5].

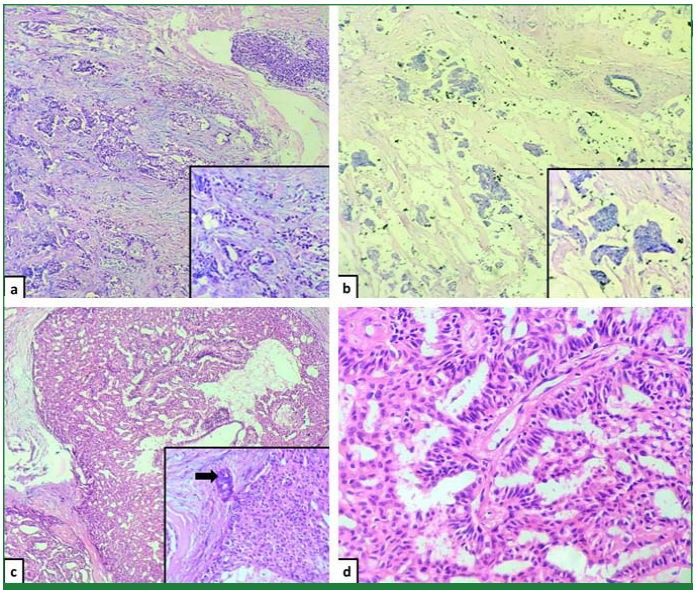
Neoplastic lesions and malignant neoplasms showed no change in the pattern of distribution of ABO blood groups with O blood group being the most common blood group. The pattern of distribution in the neoplastic lesions was not statistically significant. But the pattern



[Table/Fig-1]: a) Chronic granulomatous mastitis (H&E, X100); b) Multinucleated foreign-body giant cells (arrow) in chronic granulomatous mastitis (H&E, X400); c) Fibroadenoma (H&E, X100). Inset: Intra-canalicular pattern (H&E, X400); d) Benign Phyllodes tumour (H&E, X100). Inset: Leaf-like fronds of stromal component lined by glandular epithelium. (H&E, X 400).



[Table/Fig-2]: a) Invasive Breast carcinoma (NST) (H&E, X100). Inset: Solid nests of tumour cells (H&E, X400); b) Lymph node metastasis (arrow) in invasive breast carcinoma (NST) (H&E, X100); c) Perineural invasion (arrow) in Invasive breast carcinoma (NST) (H&E, X400); d) Invasive Breast carcinoma with medullary features (H&E, X100). Inset: Tumours cells amidst lymphocytes. (H&E, X400).



[Table/Fig-3]: a) Invasive lobular carcinoma (H&E, X100). Inset: Indian file pattern (H&E, X400); b) Invasive mucinous carcinoma (H&E, X100). Inset: clusters or tumour cells floating in the pool of extracellular mucin. (H&E, X400); c) Invasive papillary carcinoma (H&E, X100). Inset: Foci of invasion (arrow) (H&E, X400); d) Papillae with fibrovascular core in invasive papillary carcinoma (H&E, X400).

S. No	Histopathology	Cases	Percentage
A.	**Neoplastic lesions**	113	90.4 %
1.	Fibroepithelial tumours	60	48%
a.	Fibroadenoma	57	45.6%
b.	Phyllodes tumour	3	2.4%
	Benign phyllodes tumour	2	1.6%
	Borderline phyllodes tumour	1	0.8%
2.	Epithelial tumours, Invasive breast carcinoma	53	42.4%
a.	Invasive carcinoma of No Special Type (NST)	42	33.6%
b.	Carcinoma with medullary features	5	4%
	Medullary carcinoma	3	2.4%
	Invasive breast carcinoma NST with medullary features	2	1.6%
c.	Invasive lobular carcinoma	2	1.6%
d.	Mucinous carcinoma	1	0.8%
e.	Invasive micropapillary carcinoma	1	0.8%
f.	Invasive inflammatory carcinoma	1	0.8%
g.	Invasive papillary carcinoma	1	0.8%
B.	**Non neoplastic lesions**	12	9.6%
1.	Inflammatory lesions	9	7.2%
2.	Cystic lesion, Galactocele	1	0.8%
3.	Accessory breast tissue	2	1.6%
	Total	125	100%

[Table/Fig-4]: Distribution of spectrum of breast lesions.

of distribution in the malignant neoplasms was statistically significant (p=0.045). The pattern of distribution of ABO blood groups was further analysed in malignant neoplasms with respect to histological grades of invasive breast carcinoma. Grade I and grade III categories showed no change in the pattern of distribution and were not statistically significant. But grade II category lesions showed a definite change in the pattern of distribution with B blood group being most common blood group followed by O, A and AB blood groups. The pattern of distribution of ABO blood groups in grade II category was statistically considered just significant [Table/Fig-6].

Rh blood type of all the categorised of breast lesions was also analysed for the association. Rh positive blood type 118 (94.4%) was more common than Rh negative blood type 7 (5.6%). The common lesions found in Rh positive patients were fibroadenoma 53 (42.4%) and invasive breast carcinoma 53 (42.4%). The most

Breast Lesions	Total	ABO blood groups				
		A	B	AB	O	p-value*
Control	222	56 (25.23%)	67 (30.18%)	17 (7.66%)	82 (36.94%)	-
Breast lesions	125	31 (24.8%)	38 (30.4%)	7 (5.6%)	49 (39.2%)	0.271
Neoplastic lesions	113 (90.4%)	30 (26.55%)	34 (30.09%)	5 (4.42%)	44 (38.94%)	0.155
Non neoplastic lesions	12 (9.6%)	1 (8.33%)	4 (33.33%)	2 (16.67%)	5 (41.67%)	0.157
Benign neoplasms	60 (48%)	18 (30%)	14 (23.33%)	5 (8.33%)	23 (38.33%)	0.253
Malignant neoplasms	53 (42.4%)	12 (22.64%)	20 (37.74%)	0	21 (39.62%)	0.045
Non malignant lesions	72 (57.6%)	19 (26.39%)	18 (25%)	7 (9.72%)	28 (38.89%)	0.327

[Table/Fig-5]: Distribution of ABO blood groups in breast lesions.
* Chi-square test was the statistical tool used to perform the statistical analysis

Histological grades of invasive breast carcinoma	Total	ABO Blood Groups				
		A	B	AB	O	p-value*
Control	222	56 (25.23%)	67 (30.18%)	17 (7.66%)	82 (36.94%)	
Grade I	11 (20.75%)	2 (18.19%)	4 (36.36%)	0	5 (45.45%)	0.256
Grade II	35 (66.04%)	10 (28.57%)	13 (37.14%)	0	12 (34.29%)	0.050
Grade III	7 (13.21%)	0	3 (42.86%)	0	4 (57.14%)	0.315
Total	53	12 (22.64%)	20 (37.74%)	0	21 (39.62%)	0.045

[Table/Fig-6]: Distribution of ABO blood groups in histological grades of invasive breast carcinoma.
* Chi-square test was the statistical tool used to perform the statistical analysis

common lesion found in Rh negative patients was fibroadenoma 4 (3.2%). None of the categories of breast lesions were found to be statistically significant for the association with Rh blood type.

DISCUSSION

The distribution of blood groups varies across different ethnic, geographic and socioeconomic groups [9]. ABO and Rh blood groups constitute major blood groups which plays an important role in transfusion medicine [1]. The ABO blood group has been found to be associated with many diseases. Previous studies have shown significant association of various cancers like gastric cancer, pancreatic cancer, neurologic tumours, salivary gland tumours and kidney tumours with particular blood groups [2,3,9,10].

Breast cancer is the most frequent malignancy and constitutes a major cause of mortality in women globally [1]. It is one of the common malignancies among women in India [4]. There are unclear, inconsistent and conflicting reports regarding the association between ABO blood groups and breast cancer. The current study was undertaken to determine the association of ABO and Rh blood group status in patients with breast lesions.

In the present study, association between ABO blood groups and various categories of breast lesions was evaluated. Bharthiya SK et al., had also focused on the association of ABO blood groups in both benign breast disease patients and breast cancer patients in their study [4]. But, most of the studies had focused on the association between ABO blood groups and breast cancer. The total number of cases was highest number in the study conducted by Flavarjani AHM et al., (173 cases) [11]. In contrast to the other studies, the present study had less number of malignant cases. The total number of controls was highest number in the study conducted by Flavarjani AHM et al., [11]. In contrast to the other studies, Aly R et al., had

least number of controls (92 controls) [12]. In the present study, clustering of cases was seen in fifth decade. Flavarjani AHM et al., documented majority of cases in fifth decade and sixth decade in their study [11]. Bharthiya SK et al., had observed clustering of cases in fourth and fifth decade in their study [4]. Mean age of presentation of breast cancer was 49.58 years in the present study. Sujatha B et al., had documented a mean age of 45.6 years [5]. In contrast, Aly R et al., had observed a mean age of 62 years in their study [12]. Most of the studies including the present study included only female patients. Bharthiya SK et al., had not specified the gender of the patients included under the study group [4].

Apparently healthy female voluntary blood donors constituted the control group in the present study. Flavarjani AHM et al., and Aly R et al., also included healthy female voluntary blood donors under control group [11,12]. Bharthiya SK et al., had included healthy voluntary blood donors under control group in their study, but had not specified the gender of the subjects in the control group [4]. Sujatha B et al., had included healthy women under control group, but had not specified the exact nature of the control group [5]. Most common malignant lesion in the present study was invasive breast carcinoma (NST). Flavarjani AHM et al., also documented invasive ductal carcinoma as the most common malignant breast lesion in their study [11].

The pattern of distribution of blood groups in malignant neoplasms was compared with that of control group. Bharthiya SK et al., observed a definite change in the pattern of distribution of blood groups [4]. It was appreciated that A blood group was the most common blood group in the malignant neoplasms category when compared with the control population. Sujatha B et al., observed a definite change in the pattern of distribution of blood groups with B blood group being the most common blood group in the malignant neoplasms category when compared with the control population [5]. There was no change in the pattern of distribution of blood groups in malignant neoplasms in the studies conducted Flavarjani AHM et al., and Aly R et al., [11,12]. In the present study, there was no change in the pattern of distribution of blood groups with O being the most common blood group in malignant neoplasms category [Table/Fig-7] [4,5,11,12]. The distribution data was statistically significant (p=0.045) and was analysed for the different grades of malignant neoplasm. On further analysis, a definite change in the pattern of distribution of blood groups was observed with B being the most common blood group in the grade II malignant neoplasms.

Authors	Population	Most Common Blood Group	Second Frequent Blood Group	Third Frequent Blood Group	Least Common Blood Group	Total Cases
Flavarjani AHM et al., [11] (USA, 2014)	Control	O (40.69%)	A (31.65%)	B (23.14%)	AB (4.52%)	376
	Malignancy	O (42.2%)	A (28.9%)	B (23.7%)	AB (5.2%)	173
Aly R et al., [12] (Egypt, 2014)	Control	A (39.1%)	O (32.6%)	B (18.4%)	AB (9.7%)	92
	Malignancy	A (53.1%)	O (21.8%)	B (17.5%)	AB (7.5%)	160
Bhartiya SK et al., [4] (India, 2015)	Control	O (40%)	B (39.1%)	A (13.63%)	AB (7.27%)	220
	Malignancy	A (32.32%)	O (27.44%)	B (25%)	AB (15.24%)	164
Sujatha B et al., [5] (India, 2016)	Control	O (39%)	O (31%)	A (26%)	AB (4%)	100
	Malignancy	B (46%)	O (32%)	A (15%)	AB (7%)	100
Present Study	Control	O (36.94%)	B (30.18%)	A (25.23%)	AB (7.66%)	222
	Malignancy	O (39.62%)	B (37.74%)	A (22.64%)	AB (0%)	53

[Table/Fig-7]: Comparison of distribution of ABO blood groups in invasive breast carcinoma in various studies [4,5,11,12].

Bharthiya SK et al., and Aly R et al., documented A blood group as the most common blood group in the malignant neoplasms in their studies and were found to be statistically significant [4,5,12]. In contrast, O blood group was the most common blood group in the invasive breast carcinoma patients in the present study and was found to be statistically significant. Similarly, Flavarjani AHM et al., also observed that O blood group was the most common blood group in malignant neoplasms in their study, but was not statistically significant [Table/Fig-4] [11]. Solak M et al., documented that breast cancer was common in women with O and A blood groups [13]. In the present study, B blood group was found to be the most common blood group in grade II malignant neoplasms and was found to be statistically just significant. Similarly, Haswani L et al., also found that majority the breast carcinoma patients belonged to B and O blood groups and was associated with grade II and grade III neoplasms [6]. In the present study, none of the categories of breast lesions were found to be statistically significant for the association with Rh blood type.

The ABO blood groups are determined by polymorphic, antigenic substances which are located on the surface of erythrocytes and some other cells and tissues. The blood groups are characterised by small carbohydrate epitopes depending upon the presence or absence of genes A and B [1]. The ABO gene is located on chromosome 9p34. It encodes two alleles (A and B) for specific glycosyltransferase enzymes which catalyses the covalent linkage of N-acetylgalactosamine or D-galactose to H determinant which is a common precursor side chain that is finally converted to A or B antigen. The ABO blood group antigens are composed of carbohydrate moiety on extracellular surface of erythrocyte cell membranes. These antigens are not only expressed on erythrocytes but also highly expressed on the surface of a large number of human cells and tissues like epithelial cells, sensory neurons, platelets and vascular endothelial cells [10]. The ABO blood group antigens are also expressed on the malignant ductal epithelial cells [3]. Malignant cells of breast cancer and gastric carcinoma has been found to express a tumour marker called Thomsen-Friedenrich antigen (T) and its precursor Tn. Alteration in ABO antigen expression has been seen on the surface of malignant cells of a variety of tumours including breast cancer [3,12]. Modified expression of blood group antigens on the surface of malignant cells may also alter the cell motility which may in turn promote tumour progression. This may be because the genetic alterations in ABO blood group genes are common in many of the cancers. As a result, blood group antigen expression may be affected by genetic alteration of the tumour [3]. Altered glycosylation is considered as a hallmark of malignant cells in various types of cancers, particularly breast cancer [14].

Some of the factors which affect the prognosis include tumour size, oestrogen and progesterone receptor status and levels, tumour histology and rate of cellular proliferation. Many reports have documented relationship between blood groups and breast cancer [3]. Meo SA et al., opined that ABO blood type antigens increases the incidence of breast cancer and the genetic factors are most probably involved in the etiopathogenesis of breast cancer [1].

It was earlier stated that women with blood group O have some protection against breast carcinoma [4]. On the contrary, Solak M et al., found O blood group to be associated with luminal type of breast cancer which constitute majority of breast carcinoma [13]. It has been found that tumours expressing oestrogen receptor was associated O blood group [7]. Even in the present study, O blood group was common in malignant neoplasms and was statistically significant. Recently, Zouine S et al., observed loss of expression of histo-blood group (ABH) antigens in breast carcinoma in blood group B (96.3%), blood group O (81.13%) and blood group A (37.93%). Loss of H antigen with O blood group patients was associated with oestrogen receptor positivity [14].

Zouine S et al., found that the frequency of blood group B was greater in patients with breast carcinoma than the control group (blood donors) in their study [7]. Blood group B patients would

develop more aggressive malignancy than the patients with other blood group. Even in the present study, blood group B was common in grade II breast carcinoma patients. Blood group antigens may influence systemic inflammatory response which is closely related to carcinogenesis by regulating the serum levels of circulating adhesion molecules and inflammation [7]. The lack of A antigen expression in combination with expression of oncogenes like p53 has been linked to increase in cell motility, resistance to apoptosis and an increase in proliferating, undifferentiated cells that have the capacity to evade immune surveillance due to loss of differentiation markers [6].

A credible hypothesis suggests that there may be a dysregulation of the enzymatic activity of the ABO glycosytransferase, which are specifically involved in the process of intercellular adhesion, cellular membrane signaling and immune response to the host. The alteration of these surface molecules may promote malignancy. The association has been established between polymorphisms at the ABO gene locus and circulating levels of tumour necrosis factor-alpha, soluble Intercellular Adhesion Molecule (ICAM)-1, P-selectin and E-selectin. Hence, this provides the basis of influence of ABO blood group with cancer survival. The expression of soluble ICAM-1, which inhibits lymphocyte attachment to the endothelial cells by binding to the ICAM ligands on the circulating cells is significantly reduced in non O blood group patients when compared to the patients with blood group O. Reduced ICAM levels in patients with non O blood group patients may promote tumour metastasis [10]. Non O blood group patients are more likely to develop aggressive breast carcinoma [7]. Decreased survival has been observed in non O blood cancer patients and favourable prognosis has been observed in O blood group patients [10,15].

The association between the ABO blood group and invasive breast carcinoma may vary in different population, geographic location and histological grades. In the present study, the association between the ABO blood group and malignant neoplasms was statistically significant. The behaviour of invasive breast cancer varies among patients with different blood groups. It may be therefore hypothesised that knowing the blood group of breast cancer patients may be beneficial in order to triage the patients for the purpose of efficient management.

Limitation(s)

The number of cases was relatively less in comparison with other studies. Though the gender of the study group was matched with that of the control group, the age of the study group could not be matched with that of the control group. This is because the study group had a wide age range. The apparently healthy female voluntary donors constituting the control group were relatively younger and had a narrow age range and lower mean age. The selection bias could not be completely eliminated. The authors could not consider general population data as it was difficult to eliminate the various confounding factors such as co-morbid illness, age and gender. The authors considered only apparently healthy female voluntary donors as control group since the bias appeared to be relatively less. The possibility of young females developing breast lesion later on cannot be ruled out. But the blood group of an individual may be considered as a relatively constant parameter which would not vary with age. So, the authors considered the healthy female voluntary donors as the control group since the bias appeared to be relatively less.

CONCLUSION(S)

Malignant breast lesions were common in O blood group patients and this was statistically significant. A definite change in the pattern of distribution of ABO blood group was observed between the control group and grade II malignant neoplasms with blood group B being most common among grade II invasive breast cancer patients, which was statistically just significant. It may therefore be hypothesised that knowing the blood group of breast cancer patients may be beneficial in order to triage the patients for the purpose of efficient management. In view of conflicting reports, further studies emphasising the molecular basis of association between ABO blood group and invasive breast carcinoma may be indicated.

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