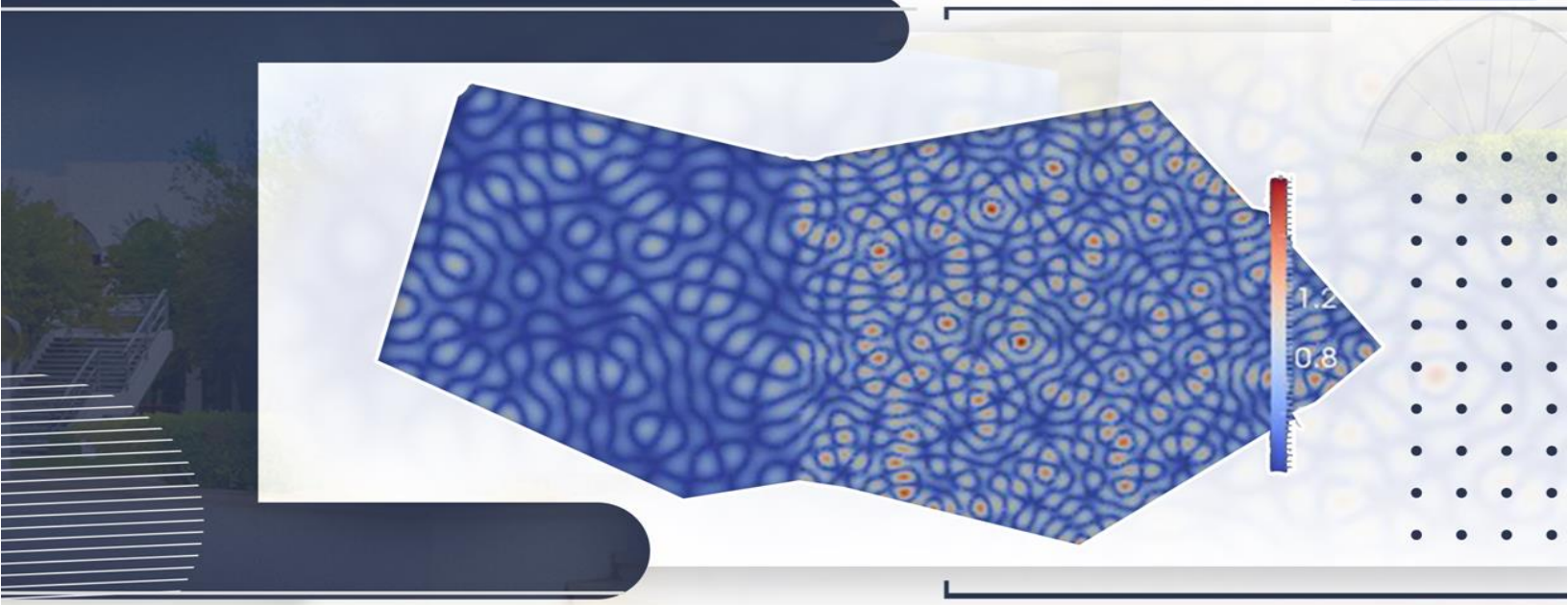
eISSN: 2789-858X

Scientific Journal for the Faculty of Science-Sirte University

DOI: 10.37375/issn.2789-858X - Indexed by Crossref, USA



Volume 2 Issue 1 April 2022

Bi-annual, Peer-Reviewed, Indexed, and Open Accessed e-Journal

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Scientific Journal for the Faculty of Science-Sirte University Vol. 2, No. 1 April (2022) 23-27

Scientific Journal for the Faculty of Science-Sirte University

Journal home page: http://journal.su.edu.ly/index.php/JSFSU/index

DOI: 10.37375/issn.2789-858X

A Study on the Relationship between Blood Group and Type of Cancer

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DOI: https://doi.org/10.37375/sjfssu.v2i1.171

ARTICLE INFO:

Received 7 December 2021.

Accepted 16 March 2022.

Published 17 April 2022.

Keywords: *Blood group, ABO, Rh factor, Cancer patients.*

A B S T R A C T

The presence and lack of blood antigens in some blood groups induce blood membrane changes, morphologically and functionally, and it is related to some kind of disease such as cancer. Structure-dependent functions of blood types can relate the blood groups to health and diseases. The study aimed to determine the association of "ABO" and "Rhesus" blood groups with the frequency of cancer. A total of 576 cancer patients participated in this study, and they were diagnosed with different types of cancer. The results showed that blood types A and O have a high rate of occurrence of breast cancer and lung cancer, the positive Rhesus blood type has a high incidence of breast cancer. Meanwhile, the Rhesus negative blood type has a high incidence of stomach cancer. In conclusion, this study supports previous studies about the relationship between the blood group type and the probability of cancers occurring.

Introduction

Blood is the most significant body fluid, which is accountable for the circulation of nutrients, enzymes, and hormones all across the body, as well as the most critical substance, oxygen (Tesfaye *et al*., 2014; Stakisaitis, *et al*., 2018). There are two systems of blood groups classification, the Rh system, and the ABO system. In the Rh system, the blood is classified into Rh-positive and Rh-negative based on the presence or absence of inherited antigenic substances on the surface of the red blood cells. The antigens could be proteins, carbohydrates, glycoprotein, or glycolipid depending on the blood group system.

In the ABO system the blood is classified to type A, type B, type AB, and type O, which codes for glycosyltransferase that gives rise to the histo-blood group antigens of the ABO system, A and B glycosyltransferases produce A or B antigens respectively on cellular surfaces and secretions (El Jellas *et al*., 2017). Hypothesis comprises a dysregulation of the enzymatic activity of the ABO glycosyltransferases, which are specifically involved in the processes of intercellular adhesion and cellular membrane signaling, as well as in the immune response to the host. The alteration of these surface molecules may promote the process of malignancy, through a mechanism analogous to the well-known role played by the ABO glycosyltransferases in modulating the circulating plasma levels of von Willbrand factor. All of these alterations lead to consequent increased risk of venous thromboembolism, which gives the role of ABO blood types as prognostic biomarkers in different types of cancers (Franchini *et al*., 2016).

Cancer is an abnormal growth of cells that tend to proliferate in an uncontrolled way and in some cases spread, the frequency of particular cancer may depend on gender and the incidence of the most significant forms of the disease has increased.

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Excess of blood group O has been reported among patients with cancer of the breast (Newell *et al*., 1974), and blood group A was associated with increased breast cancer (Khalili *et al*., 2011). Pancreatic cancer carries an increase in risk for both blood types A and B, while blood type O confers a degree of protection (El Jellas *et al*., 2017; Wang, *et al*., 2017).

Furthermore, colon cancer is the most common gastrointestinal cancer, and it is one of the relatively few diseases with a significant association with an individual's Rh blood type (Wang *et al*., 2012). Patients with the Rh- blood group type had a more favorable stage distribution than patients with the Rh+ blood group type (Huang *et al*., 2017). In addition, gastric cancer is the second most common cause of cancer death worldwide, gastric cancer can be caused by the interaction between environmental factors and genetic variations. It has been consistently observed that blood type A is associated with an increased risk for stomach cancer and reduces the chance of survival. The presence of p53 mutations is associated with stomach cancer and blood type A, due to glucocorticoid receptors are found in high numbers on stomach cancer cells and increased risk of gastric cancer among individuals with blood group A (Urun *et al.*, 2013). On the other hand, peptic ulcer risk was instead highest among those with blood group O, that individuals with blood group O have a higher risk of peptic ulcers than those with other blood groups, blood group A is widely considered an established risk factor for gastric cancer (Edgren *et al*., 2010).

Previous studies suggest a possible association between the ABO blood group and the risk of certain malignancies including an increased risk of ovarian cancer for blood group A versus O. Furthermore, B antigen was positively associated with ovarian cancer incidence, while blood group A was not associated with risk (Kashfi *et al*., 2018). Blood type O was a risk factor for decreased ovarian reserve whereas the presence of the A antigen (blood types A or AB) was protective for ovarian reserve, women with blood type O and the presence of the B antigen (blood types B or AB) was a risk factor for decreased ovarian reserve (Edgren *et al*., 2010).

1 Materials and Methods

Blood samples were collected from 576 patients (inside the tumor hospital) and directly stored in a blood bank inside the hospital that determine the blood type for all samples.

Statistical analysis:

The data gathered were sorted, classified, tabulated, analyzed. Frequency distribution was used as a statistical tool and utilized used Microsoft Excel in processing the data, and SPSS software. The significance level was tested using a t-test A p-value <0.05 was considered Statistically Significant. The analysis of variance was also run to detect the significant influence of the type of cancer on the parameters of complete blood count.

2 Results

Our study in a Libyan hospital processed about 502 cases (60%) were females and (40%) males during the year of 2017and 77 cases (51%) were male and (49%) were female during the year 2018.

In terms of age groups identification, most of the cancer cases in age groups between 31 to70 years (77.7%), while lower cases in age groups were more than 70 years (17.7%) and less than 31 years (4.6%).

According to cancer types, this study was comprised of 502 and 77 cancer patients in 2017 and 2018, respectively, with 300 females and 202 males in the year of 2017 and 38 females and 39 males for the year of 2018. When all cancers were taken together, the highest cases is breast cancer (37%), followed by colon cancer (19%), and lung cancer (16%). The other types were considerably lower than those above, these are thyroid and uterus cancer (8%), followed by brain cancer (4%), stomach cancer (3%) liver and pancreas (2%), and the least noted cases are leukemia (1%).

The results of the year 2017, in assessing the different types of cancers according to blood group, the high incidence among patients of blood group A^+(60%), followed by those with blood group O^+(29%), while the lowest percentage in the other blood groups. Furthermore, the patients of blood group B^+ were (0.03%) and the patients of both blood groups AB^+ and O^+ were 0.01% collectively. In addition to, the results showed that lung cancer with the highest rate among patients of blood group A^+(58%) and the blood group O^+ (36%), while the rate among patients of the other blood groups O^-, B^+ and $A^-$was 13%. Colon cancer was highest among cases of the blood group A^+ (50%) and followed among the patients with the blood group O^+ cases (35%) and other the blood groups O^-, AB^+, B^+, A^-, collectively was 13%, meanwhile, the pancreatic cancer was associated with the patients of the blood group O^+ (75%), then those with blood group A^+ (25%). The results also showed that 50% of cases of uterine cancer were among patients of the blood group O^+ and 46% were among those with blood group A and 4% among those with the blood group A^+. The blood group A^+ was associated with thyroid cancer in 53% of the cases, 27% of which were from the blood group O^+ and 2% of the cases of the disease of B^+. Brain cancer was most common among patients of the group of blood O^+(36%),

followed by those with blood group A^+(31%), then those with blood group B^+(22%), while those with AB^+ blood group had the least rate (4%). Gastric cancer was most common in cases with blood group B^-(54%), blood group AB^+(26%), and collectively with blood groups O^+ and O^-(14%). Liver cancer was found among patients with blood group O^+ only (100%). Leukemia had the highest rate among the blood group A^+ patients (75%) and blood group O^+ patients (25%).

The results of 2018 showed that the most common occurrence of breast cancer was among the patients of blood group A^+(42%), followed by patients of blood group O^+ (38%), then those patients with blood group B^+ and AB (12% and 8%, respectively). In the cases of colorectal cancer, the patients of blood group A^+ were found with the highest rate (80%), then those with blood group O^+ (20%). Among lung cancer, the blood group A^+ patients have recorded the greatest rate (50%), then those with blood group O^+ (39%). The proportion of blood group A^+ patients among stomach cancer was (25%), while the proportion of patients with blood group B^- was (75%). Meanwhile the prostate cancer incidence was equal between the patient of the blood groups A^+ and B^+ 50% each.

Complete Blood Count (CBC) Test results

The analysis of variance revealed that the type of cancer was insignificantly (P>0.05) affected the amount of WBCs, HGB, RBCs and PLT, while the means separation showed that the prostate cancer patients had significantly higher HGB (10.33) than other cancer patients. On the other hand, the overall means of PLT, HGB, RBC, and WBC were found to be 223.58, 11.00, 3.98, and 6.78, respectively (Table 1).

Table (1). The complete Blood Count (CBC) parameters among cancer patients during year, 2018

Cancer type	No	PLT	HGB	RBC 10^6	WBC 10^3
Lung	18	215.78[a] ±120.89	10.68[a]± 2.34	3.77[a] ±0.82	6.93[a]± 3.66
Colon	15	219.07[a] ±58.21	11.26[a]± 1.79	3.99[a] ±1.01	7.89[a]± 3.68
Breast	24	236.29[a] ±121.48	11.02[a]± 2.41	4.00[a] ±0.56	6.88[a]± 2.64
Pancreas	5	275.80[a] ±80.40	10.54[a]± 0.60	4.31[a] ±0.99	5.54[a]± 1.92
Stomach	4	216.25[a] ±37.98	10.48[a]± 0.19	4.10[a] ±0.89	5.18[a]± 0.81
Prostate	3	150.00[a] ±111.32	14.33[b]± 0.90	4.53[a] ±0.93	6.30[a]± 1.15
Ovary	3	232.00[a] ±51.29	10.33[a]± 1.19	3.59[a] ±0.55	5.37[a]± 2.31
Cervix	2	157.00[a] ±26.87	9.95[a]±0. 64	4.23[a] ±1.51	5.10[a]± 1.41
Overall	74	223.58± 100.77	11.00±2 .09	3.98± 0.80	6.78±3 .00
Sign. Level		**NS**	**NS**	**NS**	**NS**

NS: Insignificant at P>0.05, a, b: Means with the same superscript were insignificantly different (P<0.05)

3 Discussion

Although, previous studies showed that many factors related to the occurrence of cancer, including external factors and inside body factors, still some doubt in the internal factors and their relationship to cancer and the type of cancer. In general, the results 2017 of this study suggested that there was a strong relationship between the blood group O^+ and most types of cancer, as well as a strong relationship between blood group A^+ and three types of cancers, namely colon, breast, and lung cancer. While medium relationship between blood group B^- with stomach cancer and blood group B^+ with breast cancer and prostate cancer and blood group AB^+ with breast cancer and blood group A^+ with lung cancer. It was noted that a weak relationship between B^+ blood type and prostate cancer, brain and uterine cancer, as well as a weak association with ovarian cancer and uterine cancer with the O^+ group, and also a weak association between AB^+ blood group with thyroid cancer and A^+ blood group with gastric cancer, prostate cancer, and ovarian cancer, A^- blood group with lung cancer.

According to the results of the present study, rate females are affected with cancers more than males. Another study shows similar results and that female have a high population than males, so this difference shows that men are more susceptible to colon cancer than women; most colon cancer cases in this study were married (72.2%) which can be related to problems that expose the married group to stresses and make them susceptible to many diseases including cancers (Ba *et al.*, 2017). The results of this study showed that colon cancer as the third type of cancer, the ratio is (21%) at blood group A^+ (80%) and O^+(20%) of analyses, showed relationship blood groups and different types of cancer, there was no statistical significance P>0.05, so no significant relationship between blood group and colon cancer. The highest frequency of colon cancer was observed in cases with blood group O^+ (47.8%) and B^+ (26.9%) (Kashfi *et al*. 2018).

Compared to the incidence in the general population, the analyses showed a relationship between blood group and colon cancer, the most patients with colon cancer (90.4%) had a positive Rh, which is almost in line with the Rh-positive frequency in the general population (92.3%). Although, the results of the study showed no important relationship between Rh and colon cancer ($P > 0.05$) (Sarafian *et al*., 1993a).

According to many studies, one of the genetic factors is blood group, the results of this study showed a higher frequency for cancer cases in blood group O^+ than in other groups and an important relationship between colon cancer and blood group of subjects (Sandlerand Mallory, 1995; Dabelsteen, 2002; Cooper, 2000).

The results of this study showed that the highest proportion of cancers in breast cancer spreading is a high rate in Libya and more exposed females (33%). The results of the year 2017 breast cancer is a high rate in blood group A^+ with rate of 60% and O^+ with rate of 29%, while the rate in blood groups B^+ is 3%, in blood groups $B^-$is 5%,$AB^+$is 1% and blood group O^- is 2%.

Furthermore, some previous studies have reported significant associations between the ABO blood group or Rh factor and breast cancer risk, overall the literature is inconsistent. The majority of the larger studies published to date observed no association with Rh factor and/or ABO blood group, while some studies tended to report significant associations (Lu *et al*., 2011; Hallouin *et al*., 1997; Sarafian *et al*. 1993b; Iwamoto *et al*., 1999). Blood type reported positive associations between type A and risk of breast carcinoma (Hallouin *et al*., 1997; Sarafian *et al*. 1993b). However, the other study reported a positive association between type O and breast cancer risk (Ba *et al*., 2017). the other hand, 48% of the patients with HELLP syndrome had a negative blood type O and Rh and they were at a greater risk for the syndrome (Cooper, 2000).

Blood group B has a correlation with heart disease in males and cancer in the upper third of the esophagus (Dean, 2005). Blood group A was more common in patients with pancreatic cancer and the blood group seems to be a protective agent against pancreatic cancer (Dabelsteen and Gao, 2005). As well as people with blood group O had higher survival compared to people with other blood groups.

Compared to other blood groups, the frequency of blood group A was higher in women with ovarian cancer. In addition, the relationship between ABO blood groups and the main risk factors for cardiovascular disease in the general population of Golestan province (Chihara *et al*., 2005), it was shown that, blood group O has the highest frequency and blood group A has a more family history of heart disease compared to other blood groups.

4 Conclusions

Cancer risks vary in people with different ABO blood types, with higher risks of breast cancer, lung cancer, and colon cancer associated with blood type A+ and pancreatic cancer associated with non-O blood types A^+,B^+ and AB^+, while the stomach cancer with blood type B^-. In conclusion of this study, there is a relationship between some blood groups and the type of cancer but is not clear that it is likely to increase the other surrounding factors of this relationship or reduce the strength of the link between the two variables and this depends on internal genetic and physiological changes.

Conflict of Interest: The authors declare that there are no conflicts of interest.

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