CHAPTER-FIVE

Discussion
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5.1 Prevalence
Approximately 2 to 9 percent will form a new alloantibody after the transfusion of one or more units of RBCs. Therefore, the reported frequency of alloantibody formation is highly variable in different parts of the world ranging from 1.13% to 40.4%. RBC allo-immunization results from the antigenic disparity of RBCs between donor and recipient or between mother and fetus and is one of the complications of RBC transfusion in addition to immunological complications of repeated RBCs transfusions include difficulties obtaining compatible packed RBCs, development of auto-antibodies, acute or delayed hemolytic transfusion reactions, and hemolytic disease of the newborn. Current standard pre-transfusion testing protocols require detection and identification of clinically significant allo-antibodies reacting in antihuman globulin (AHG) phase after incubation at 37°C. The information ready on allo-immunization particularly in India country is restricted to select illness populations like multiple transfused cases or pregnant and very limited information are obtainable for general cases.

In present study, the overall alloimmunization rate was 18.3% which was low when compared with a study done by (Schonewille H. et al. 2006 In Netherlands) their study period was long whereas first part the alloimmunized rate was 21.4 % but at the end of their study was 33.4 % of patients had multiple antibodies.

The highest reported frequency, in the United Kingdom, is 76%, followed by reports from the United States were 42.9%, 34.8%, and 34%. Reports from Taiwan (37%), Kuwait (30%), and Greece (21.1%) but most of the aforementioned studies specifically focused on patients with thalassemia and SCD, while our study included ten types of patients.

Similarly with previous study done by (Hundric-Haspl Z. et al. /In Croatia) found in patients with hematologic diseases the frequency of clinically significant alloantibodies was 17.6%, in patients with uremic disease it was 14%, and in patients with cirrhosis it was 6.9%.
Seemingly in contrast with our findings, more studies reported low alloantibodies rate as (Amina H Hassab et al. 2008 In Egypt) \(^9\) reported alloantibodies rate was 10.5% in Repeatedly Transfused Patients. While (Tatjana Makarovska et al. 2017) \(^{32}\) reported RBC alloantibodies rate was 10%, Natukunda B. et al. 2010\(^{30}\) they reported (6.1%) in transfused Ugandans with different diseases and (Fawwaz Al Joudi et al. 2011in Malaysia) \(^7\) that showed of the overall prevalence of alloimmunization was (1.13%). This difference could be due to varied study populations, and the frequency of RBC alloantibodies varies considerably depending upon numerous factors, for example, demographics, number of transfusions, pregnancy, genetic constitution, immune competence, disease factors, time and frequency of screening, and sensitivity of the methodology.\(^{42}\)

In present study the high prevalence of alloantibodies because many reasons; First most blood banks depend on cross-match only for blood transfusion that is not enough to do international standards of blood transfusion safe; Second most blood banks did not do antibody screening and identification because no facilities in blood bank and/or high cost of these test and most patients don’t have its cost; Third most blood banks did not do antigen phenotype (at least Rh and Kell); Forth most of our samples were depending to require of Doctors treatment after suffering from incompatible of blood in their hospital, and DCT or ICT was positive, therefore Doctor suggests present of alloantibody in patient then send the patient to do antibodies screening and identification.

The reasons for this could be that our study population comprised all private and public hospital illness and those high hazard groups because they require to multi-transfusion, in addition, some cases require regular packed RBCs transfusions. Also the allo-antibody detection/screening method used at our centre is specific for IgG antibodies that is done after some investigations as DCT, ICT, auto control, DC screening and antibody screening by three cell. Various studies have used different methods for antibody screening and identification that may also detect IgM antibodies, indicating detection of a significant proportion of antibodies which are not clinically significant yet detected.

The genetic and demographic differences in between these donors and Indian patients are inevitable. Although several studies have not been confirmed this association.\(^{41}\)
5.2 The most Alloantibodies Incidence / Clinically Significant

Total prevention of RBC alloimmunization and HTRs is unrealistic, because current immunohematological methods of testing are not sensitive enough to detect all RBC antigen and antibodies.  

Most of these antibodies are clinically significant and have been implicated in delayed hemolytic transfusion reactions (DHTRs) and Hemolytic disease of the newborn (HDN). The high incidence of anti-E, anti-D and anti-c reflects a heterogeneous distribution of these antigens in our population.

In present study, out of 16 types deferent alloantibodies detected (M, E, D, C, c, e, N, Fy^a, Le^a, Le^b, K, Jk^a, Jk^b, P^1, Fy^b and Anti-S illustrated in table 1), representative in 18 cases expounded in Figure 3. The most alloantibody/case frequent combination was Anti-M (n=9, 18.7%) which is detected in 9 patients, Anti-E (n=6, 12.5%), Anti-D (n=6, 12.5%), Anti-C (n=5, 10.3%), Anti-c (n=3, 6.2%), Anti-e (n=2, 4.2%), Anti-N (n=3, 6.2%), Anti-Fy^a (n=2, 4.2%), Anti-Le^a (n=2, 4.2%), Anti-Le^b (n=2, 4.2%), Anti-K (n=1, 2.1%), Anti-Jk^a (n=1, 2.1%), Anti-Jk^b (n=1, 2.1%), Anti-P^1 (n=1, 2.1%). Some patients were have dual alloantibodies Anti-E+ Fy^b (n=1, 2.1%), Anti- Fy^b+S (n=1, 2.1%) and Anti-D+C (n=1, 2.1%) while one patient was have triple alloantibodies Anti-C+E+K (n=1, 2.1%). Where all antibodies were IgG class except Anti-M was IgG & IgM.

The ethnic distribution of alloantibodies indicates that Indians are predominantly affected, which is attributable to the fact that Rajasthan State is populated by a great majority of Indians.

5.3 Rh System

All previous studies conformed that Rh alloantibodies most frequency in the world and related with hemolytic transfusion reactions and Hemolytic disease of the newborn.

In present study, the most common alloantibodies produced were against Rh system (50.8 %), the prevalence was high and the most common among Rh was Anti-E (15%) flowed by Anti-D (13.3%) and Anti-C (13.2%), Anti-c (5.6%) and Anti-e (3.8%). The high frequency in our study because antigen phenotype (at least RH and Kell) did not had done by most blood banks.
In previous studies, the frequencies of Rh antibodies were uneven whereas (Fawwaz Al Joudi et al. 2011) reported anti-E was the most common (24.6%) in their study. While (Rabeya Yousuf et al. 2013) found anti-E (18.6 %) and anti-D (13.7 %). Anti-E and anti-c were the most common combination of multiple alloantibodies. (Hundric-Haspl Z. et al. 1994) found anti-E (20%), anti-D (11%), anti-c (10%), anti-C (7%). (Bernard Natukunda et al. 2015) Reported that Rh antibodies were (E, D, C, Cw. 10, 7, 2, and 1).

As is evident from our results and existing literature the most common alloantibodies found were against the common Rh and Kell antigens (D, C, c, E, e, K), comprising nearly 71 percent of the total alloantibodies identified.

5.4 Kell System

Low prevalence of anti-K in our study (1, 9%) could be due to low frequency of Kell antigen in Indian population. Most of the studies done outside India reported incidence of anti-K more than (1.9%).

In previous studies, the frequencies of Kell antibodies were uneven whereas the most common of (Anti-K 28.5%) found by (Karageorga et al. 1990). (Hundric-Haspl Z. et al. 1994) found it about (anti-Kell 22%) as the most frequently in their study. While (Amina H Hassab et al. 2008) found anti-K in 4 (19%), anti-Js (4.8%), (Christopher A. Tormey et al. 2008) found K (21.9%) and (Khademi Reyhaneh et al. 2013) found anti-K (23.53%).

(Banu Aygun et al. 2002) found Kell antibodies in pediatric were (22%) while in adult were (10%). And there many studies did not found Kell antibodies.

5.5 Duffy System

The frequency of Anti-Fy (3.8%), Anti-Fy (3.8%) was low, almost closely correlated with the results of most previous studies. Antibodies against the Duffy antigens have all been implicated as the cause of HTR and HDFN.

(anti-Fy 4.8%, 10.2, 2.6), (Fy 7.7%, 2.5, 0.65) There many studies did not found Duffy antibodies through their study.

In previous studies, the frequencies of Duffy antibodies were uneven whereas (Amina H Hassab et al. 2008) found it about (anti-Fy 4.8%) in their study. While (Tatjana Makarovska et al. 2017) found -Fy (10.2%), -Fy (2.5%), (Abdel Galil M. et al.
2008) found anti Fy\(^a\) (2.63%), anti Fy\(^b\) (0.65%), and (Cheng CK. et al. 2012) found anti-Fy\(^b\) (7.7%). (Kangiwa et al. 2015) Reported also that Duffy antibody was (13.3%). There many studies did not found Duffy antibodies through their study.

### 5.6 Kidd System

The prevalence rate of Anti-Jk\(^a\) (1.9%), Anti-Jk\(^b\) (1.9%) were low compressed to previous studies could be due to low frequency of Kidd antigen in Rajasthani population.

In previous studies, the frequencies of Kidd antibodies were uneven whereas (Cheng CK. et al. 2012) found it about (anti-Jk\(^a\) 15.4%) in their study. While (Eiman Hussein et al. 2014) found the anti-Kidd (8.9%). There many studies did not found Duffy antibodies.

### 5.7 MNS System

Anti-M and anti-N are not considered to be a cause of transfusion reactions, although rare cases of delayed transfusion reactions have occurred as a result of anti-M. In present study, Anti-M was the most common combination of multiple alloantibodies (Anti-M 18.9%) but it is not clinical significant because it is fairly common and is thought to mostly be naturally occurring because it is frequently found in children who have never received a blood transfusion. While Anti-S was (1.9%) that is more clinical significant because it is can be cause mild to moderate transfusion reactions in the patient's serum. And Anti-N (5.6%) frequency was high but it is not clinical significant.

In previous studies, the frequencies of MNS antibodies were uneven whereas (Rabeya Yousuf et al. 2013) suspected Anti-M alloantibody was observed most frequently (30.4 %) in their study. While (Bernard Natukunda et al. 2015) found MNS (S, M, 4, 1). (Fawwaz Al Joudi et al. 2011) Reported anti-M was (13.8%). (C. K. Lee et al. 2003) found anti-S (6%) and anti-Mi (6%). (Amina H Hassab et al. 2008) found anti-N and anti-s in one patient (4.8%). There many studies did not found MNS antibodies.
5.8 Lewis System
In present study the frequency [Anti-Le\textsuperscript{a} (3.8%), Anti-Le\textsuperscript{b} (3.8%)] was low comprised to previous studies but it is not clinical significant because Lewis antibodies do not cross the placenta and the antigens are poorly developed at birth, the antibodies have not been implicated in HDN.\textsuperscript{90}

In previous studies, the frequencies of Lewis antibodies were uneven whereas (Fawwaz Al Joudi et al. 2011)\textsuperscript{7} found it about (anti-Le\textsuperscript{a} 18.5%) in their study. While (B. Suresh et al. 2015)\textsuperscript{73} found the anti-Le\textsuperscript{a} and anti-Le\textsuperscript{b} were (4.5%). There many studies did not found Lewis antibodies.

5.9 P system
In present study the Anti-P\textsuperscript{1} in our study (1.9%) was low comprised to previous studies, the frequencies of P antibodies were uneven whereas (Christopher A. Tormey et al. 2008)\textsuperscript{33} found it about (P\textsuperscript{1} 3.9%) in their study. While it in other side high comprised to previous study carried out by (Eiman Hussein et al. 2014)\textsuperscript{59} as they found anti-P\textsuperscript{1} (1.6%). There many studies did not found P antibodies.

5.10 Female: male Ratio
Some studies reported there association between alloimmunization and gender, while others said no relation.

In our study, the rates of alloimmunization among female patients about 33 cases out of 136 (24.3%) more than male patients 15 cases out of 127 (11.8%). Female and male immunized ratio was (2.1:1).

A higher rate of allo-immunization was observed in females than in males. A similar observation was made by Hoeltge et al\textsuperscript{29} as they found higher percentage of immunized females than males. Higher rates of allo-immunization in females may be attributed to antigenic exposure during pregnancy in addition to transfusions\textsuperscript{41} also pregnancy anemia, bleeding due to disorders of the menstrual cycle, bleeding through birthing, cesarean section. While, in men the packed RBCs transfusion is only source of antigen exposure.

In previous studies, reported that allo-antibodies frequency in female more than male.\textsuperscript{3, 6, 7, 36}
On the contrary some studies did not found relation between female and high frequency of allo-antibodies.

5.11 Association of Alloimmunization with Number of Transfusions

Alloimmunization result from exposure the patients to foreign antigen after transfusion, therefore the incidences reported in several studies on transfused patients seem to indicate that the risk of alloantibody formation rises with an increasing number of transfusions. 103

Although some studies reported that no relation between allo-immunization and numbers of units, that they showed immunized case from first transfusion.

In present study, we found immunized case results from one unit of blood transfusion, nevertheless we found some patients received more than five units but not immunized.

Earlier transfusion and the number of transfusions have been identified as a significant determinant of allo-immunization. 41

The cumulative incidence of allo-immunization increased with the number of RBC transfusions. 77

In such circumstances, transfusion therapy may become significantly complicated. Effects of allo-immunization may include difficulty in finding compatible RBC units because of the presence of clinically significant RBC antibodies, transfusion reactions, or platelet refractoriness. 33

It was concluded that the findings of this work have been comparable with other published works, and that the main factors associated with alloantibody formation were multiple transfusions and pregnancies. 7

5.12 Association of Alloimmunization with Age Progress

With progress of age the immune system is high sensitive and active after that decrease the activity on old age. When illness receive packed RBCs and exposure to extra/foreign antigen the immune system response will produce antibody dependent to immune activity state that is has relation with age. Verduin EP. et al. (2015) worked on “Female sex of older patients is an independent risk factor for red blood cell allo-immunization after transfusion”. The reported that the adjustment for confounders
resulted in a relative 80% higher risk in women older than 45 years of age. Therefore, RBCs allo-immunization increased with age. In present study, we observed increase immunization cases with age, because increases the number of blood transfusing through patients’ life (Table: 8) The high frequency of allo-immunization in (1-10) age group because most of them having hemoglobinopathy as Thalassemia patients and cancer, that some of them started received blood when his/her age under one year additional to hemolytic of newborn disease therefore we found many patients were immunized.

The most frequency of allo-antibodies showed in patients group (21 – 50 years) because this group includes women pregnancy and chronic renal failure that are need regular blood transfusion therefore more exposure to foreign antigen that causes immunization of patients.

While high frequency of immunization patients group over 60 years old, because most of patients having anemia results physiology disorders and degrease of blood products from yellow bone morrow and this group prone to disease as cancer and others that causes surgical intervention.

<table>
<thead>
<tr>
<th>Age</th>
<th>Patients</th>
<th>Immunized</th>
<th>Immunized Percent/ 48</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-10</td>
<td>35</td>
<td>06 (17.2%)</td>
<td>12.5</td>
</tr>
<tr>
<td>11-20</td>
<td>23</td>
<td>00</td>
<td>0</td>
</tr>
<tr>
<td>21-30</td>
<td>68</td>
<td>13 (19.1%)</td>
<td>27</td>
</tr>
<tr>
<td>31-40</td>
<td>39</td>
<td>09 (23%)</td>
<td>18.7</td>
</tr>
<tr>
<td>41-50</td>
<td>32</td>
<td>04 (12.5%)</td>
<td>8.4</td>
</tr>
<tr>
<td>51-60</td>
<td>36</td>
<td>10 (27.75)</td>
<td>20.8</td>
</tr>
<tr>
<td>61-70</td>
<td>20</td>
<td>03 (14.3%)</td>
<td>6.3</td>
</tr>
<tr>
<td>71-80</td>
<td>08</td>
<td>03 (37.5%)</td>
<td>6.3</td>
</tr>
<tr>
<td>81-90</td>
<td>02</td>
<td>00</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>263</td>
<td>48</td>
<td>100</td>
</tr>
</tbody>
</table>
5.13 Association of Alloimmunization with Blood Group System and other Blood Groups

The patient dose not has antigens in his body will products antibody against foreign antigens. Therefore, the most immunized case are patients having Rh negative blood group produced anti-Rh after blood transfusion or pregnancy.

In present study, among 26 Rh (D) negative patients (Immunized 9 case-34.6%), while 237 patients among Rh (D) positive (Immunized 39 case-16.5%).

As is evident from our results and existing literature the most common alloantibodies found were against the common Rh (D, C, c, E, e) (50.8%), comprising nearly 50 percent of the total alloantibodies identified. Flowed by MNs system (26.4%), Duffy system (7.6%), Lewes system (7.6%), Ked system (3.8%), Kell system (1.9%), P system (1.9%). (Table: 9)

Table 19 Rh and Other Blood Groups Distributions:

<table>
<thead>
<tr>
<th>Blood group system</th>
<th>Alloantibodies</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rh system</td>
<td>E -15%, D- 13.2%, C-13.2%, c- 5.6%, e-3.8%</td>
<td>50.8</td>
</tr>
<tr>
<td>MNs system</td>
<td>M-18.9%, N-5.6%, S-1.9%</td>
<td>26.4</td>
</tr>
<tr>
<td>Duffy system</td>
<td>Fy^a-3.8%, Fy^b-3.8%</td>
<td>7.6</td>
</tr>
<tr>
<td>Lewes system</td>
<td>Le^a -3.8%, Le^b-3.8%</td>
<td>7.6</td>
</tr>
<tr>
<td>Ked system</td>
<td>Jk^a -1.9%, Jk^b-1.9%</td>
<td>3.8</td>
</tr>
<tr>
<td>Kell system</td>
<td>K-1.9%</td>
<td>1.9</td>
</tr>
<tr>
<td>P system</td>
<td>P1- 1.9%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total 100</td>
<td></td>
</tr>
</tbody>
</table>

Table 20 Demographic Details, ABO and Rh System Distribution:

<table>
<thead>
<tr>
<th>ABO Groups</th>
<th>Total Attended/%</th>
<th>Immunized / %</th>
<th>Rh</th>
<th>Total Attended</th>
<th>Immunized Case</th>
<th>Immunized % of 48</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Group</td>
<td>68/25.8</td>
<td>11 /22.9</td>
<td>A+</td>
<td>58</td>
<td>8 (13.8%)</td>
<td>16.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A-</td>
<td>10</td>
<td>3 (30%)</td>
<td>6.3</td>
</tr>
<tr>
<td>B Group</td>
<td>96/36.5</td>
<td>13 / 27.1</td>
<td>B+</td>
<td>90</td>
<td>12 (13.3%)</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>B-</td>
<td>6</td>
<td>1 (16.6)</td>
<td>2.1</td>
</tr>
</tbody>
</table>
In Table:10 Patients having O blood grouping were 71 patients, immunized cases were 16 (33.4%) it is high prevalence compare with other blood groups flowed by B blood grouping were 96 patients, immunized cases were 13 (27.2%), A blood grouping were 68 patients, immunized cases were 11 (22.9%), finally AB blood group were 28 patients, immunized cases were 8 (16.6).

Immunized rate in patients having O blood group more than other blood groups because most of them were female and thalassemia patients that they are more exposure to foreign antigen; Female and male immunized ratio was (2.1:1). While patients having B blood group, were more participated in this study 96 patients. In other side the immunization rate in patients having A blood group was high because mali subgroup A1, A2 etc.

**BECAUSE OUR STUDY INCLUDED 10 TYPES OF PATIENTS WE WILL EXPLAIN BRIEFLY EVERY TYPE SEPARATE**

### 5.14 Thalassemia

RBC transfusion is main way to treatment or saving Hb normal level in thalassemia patients but it is confronted with numerous complications. In almost every patient, the transfusion requirement slowly increases over the years. Therefore, the reported frequency of antibody formation is highly variable in different parts of the world ranging from 1.13% to 40.4%.

In present study, out of 47 thalassemia patients, about 7 of them immunized and antibody prevalence was 14.8% with antibody specificity anti- Rh system and anti-M but anti-K did not found. Few studies reported comparison of prevalence and antibody specificity. There are also studies that found higher and lower immunization rates. In Egypt, the prevalence was (28.4%)\textsuperscript{57}, in Chinese (23.0%)\textsuperscript{49}, in Asian descent (22%)\textsuperscript{49}, in Thailand (17.5 %)\textsuperscript{47}, in Pakistan (8.5%)\textsuperscript{44}, in Iran 10%\textsuperscript{28}, in India 5.64%\textsuperscript{6}.
The high prevalence may be expected when there is no homogeneity of RBC antigens between the blood donors and recipients didn’t use leucodepleted red blood cell, didn’t do antigens phenotype (Rh and Kell).

5.15 Chronic Renal Failure

The patients of chronic renal failure who have received blood transfusions are also at risk of alloimmunization. Although, recombinant human erythropoietin (RHuEpo) has revolutionized the treatment of patients with anemia of chronic renal failure but the blood transfusion still final treatment of anemia in chronic renal failure.

We observed of alloimmunization prevalence was 15.4 % detected in 6 out of 39 CRF patients, this finding is higher than the frequency of previous studies have done in Sudan country that they reported of prevalence 13.1 %68, Similarly study by Domen and Ramirez showed the rate 6.1 %10 and frequency of 9.9 % reported by Shukla26 in CRF patients undergoing dialysis while study by Patel et al.11 had been shown that the alloimmunization rate 8.2 % in CRF patients.

The high prevalence in our study may be because little number of patients. In spite of there are many chronic renal failure patients in the Jaipur but lack of cooperation from most hospitals and did not allow us to collect samples from all centers.

5.16 Previous Blood Transfusion

In this patients group some of them received only one unit and other received many units results temporary anemia, bleeding, accident, surgery and others case.

In present study, we collected from 22 patients and found 5 of them immunized (22.7%), this confirmed the alloantibody may produce from first transfusion. That is reported in previous studies; approximately 2 to 9 percent will form a new alloantibody after the transfusion of one or more units of RBCs.23

5.17 Surgery Cases

If patient lose more than 20% of the blood normally in his body, he/she will need a blood transfusion to replace it.

Ninety percent of this patients group needs to urgent blood transfusion specific large surgery, therefore these more exposures to foreign antigens.
In present study, we collected from 22 patients most of them was old age, we found 5 immunized patients (22.7%). The high prevalence of allo-antibody because most of illness was old, heterogeneity of patients with donors and previous pregnancy.

5.18 Mothers Having Negative Blood Grouping

Through literature review all past studies conformed of mother having negative blood grouping more prone to antibody formation specific if her fetes were positive blood group.

In our study, we collected from 8 mothers having negative blood grouping and we found 2 women had immunized (25%). Note that the previous studies that found higher and lower immunization rates. Meena Sidhu et al. 2016 \(^{72}\) found about 2 % (21 % in D-negative and 0.45 % in D-positive), Jophy Varghese et al. 2013\(^{21}\) observed that, allosensitization with clinically significant antibodies was found in 9.43 % Rh (D) negative and in 0.08 % Rh (D) positive women. While Jalada Patel et al. 2009\(^{71}\) reported that bad obstetric history cases had significantly higher incidence of alloimmunization.

5.19 Leukemia

Most of leukemia disease associated with anemia, the blood transfusion require to treatment anemia additional to compensate of leukocyte cells.

In present study, we collected from 8 patients and found only one immunized patient (12.5%) lower than reported by (Sanz C et al. 2013)\(^{77}\) worked on “Red blood cell alloimmunization in transfused patients with myelodysplastic syndrome or chronic myelomonocytic leukemia”. They found that 42 immunized patients, alloimmunization rate was (15%), formed 81 alloantibodies and seven autoantibodies.\(^{77}\)

5.20 Liver Diseases

In this patients group usually having anemia, blood transfusion required to balance Hb level additional to transplant of liver need to blood through surgery and after that also, therefore they more exposure to foreign antigen. Luzzo AC. et al. 2010\(^{75}\) reported alloimmunization (23%) was slightly higher among patients than in the literature.
In present study, we collected from 6 patients and found only 2 immunized patients (33.33%). The high prevalence because little of samples, heterogeneity of patients and donors and may be alloantibody produced against foreign antigens in transplant liver.

5.21 Bleeding Cases

Bleeding disorders (acute and chronic) or temporary bleeding leads to the lost of blood, the treatment of bleeding disorders want more time, therefore the patient need to urgent blood transfusion, as a result of transfusion the patients may products alloantibody.

In present study, we collected from 6 patients and found 2 of them immunized (33.33%), consequently the patients exposure to foreign antigen. The frequency was high because little of samples, heterogeneity of patients with donors and most of blood banks depend only cross-match before blood transfusion, the high prevalence of alloimmunization could be due to high incidences of RBC antigenic exposures in this group.

Finally:

It was concluded that the findings of this work have been comparable with other published works, and that the main factors associated with alloantibody formation were multiple transfusions and pregnancies.