Int. J Med. Pharm. Res. (P-ISSN: 2958-3675 | E-ISSN: 2958-3683)
Available on: https://ijmpr.in/

International Journal
of Medical and Pharmaceutical Research

ORIGINAL ARTICLE **OPEN ACCESS**

Prevalence Of Hepatitis-C in Multitransfused Thalassemia Patients in a Tertiary Care Hospital, Dhaka, Bangladesh

Sajeda Sultana[1], Md. Selimuzzaman[2], Md. Abdul Wohab[3]
[1]Junior Consultant, Department of Paediatric Haematology and Oncology, Bangladesh Shishu Hospital & Institute, Dhaka, Bangladesh
[2]Professor & Head, Department of Paediatric Haematology and Oncology, Bangladesh Shishu Hospital & Institute, Dhaka, Bangladesh
[3]Associate professor, Department of Paediatric Haematology and Oncology, Bangladesh Shishu Hospital & Institute, Dhaka, Bangladesh

OPEN ACCESS

***Corresponding Author**
Sajeda Sultana
Junior Consultant, Department of Paediatric Haematology and Oncology, Bangladesh Shishu Hospital & Institute, Dhaka, Bangladesh

Received: 15-01-2025
Accepted: 18-02-2025
Available online: 28-02-2025

A B S T R A C T

Background: Multitransfused thalassemic patients have high prevalence for HCV infection. In developing countries, HCV antibody is reported to be high in this group of patients. **Objective:** To see the prevalence of Hepatitis C in multitransfused Thalassemic patients. **Methods:** This cross-sectional observational study was carried out in children with B- Thalassemia from outpatients department of haemato oncology, Shishu Hospital, Dhaka during February 2015 to August 2015. After fulfillment of inclusion and exclusion criteria patients here enrolled in this study and an ID no. was tagged to each of them. The subject was informed detailed about the study and consent was taken. A checklist was used for interviewing the parents, children and recording of demographic information, findings of physical examination and laboratory investigation were collected and under strict aseptic conditions and were sent to the department of Pathology for labrotory tests. Complete Blood Count with film, Serum bilirubin, SGPT, Prothrombin time, Serum Albumin, HBSAG, Anti HCV, USG of hepato biliary system. **Results:** Anti HCV was found 11 (18.3%) of the study patients. The mean age was 7.4±3.09 years with ranged from 4 to 16 years. Male to female ratio was 1.5:1. More than three fourth (78.4%) patients came from middle class family. All patients were immunized, 39(65.0%) had jaundice and 20(33.9%) had consanguinity. Two third 40(66.7%) patients had hepatomegaly, followed by 10(16.7%) had Splenectomy. Majority (86.6%) patients had Hb% level between to 5-10 gm/dl. HBsAg positive was found in 4(6.7%) of the study patients. Anti HCV positive found in 11 (18.3 %) of multitransfused thalassemia patients. Regarding the history and physical examination, 10(90.9%) patients had jaundice in anti HCV positive and 29(59.2%) in anti HCV negative. Abdominal pain found 6(54.5%) in anti HCV positive and 7(14.3%) in anti HCV negative. Jaundice and abdominal pain were significantly higher in anti HCV positive cases and other were not statistically significant between two groups. The mean weight was 24.6±8.8 kg in positive group and 15.8±5.5 kg in negative group. Mean splenomegaly was 13.9±2.7 cm in positive group and 9.6±5.2 cm in negative group. Mean hepatomegaly was 12.9±2.9 cm in positive group and 9.4±5.2 cm in negative group. The weight, splenomegaly and Hepatomegaly were significantly ($P<0.05$) higher in anti HCV positive cases. HBsAg positive was found in 4(8.2%) of the patients having Anti HCV negative group but not found in positive group. The difference was not statistically significant ($P>0.05$) between two groups. The mean S.bilirubin was 2.2±0.5 mg/dl in positive group and 1.5±1.1 mg/dl in negative group, which was significantly ($P<0.05$) higher in anti HCV positive cases. **Conclusion:** Anti HCV positive was found 18.3% in multitransfused thalassemic patients.

Keywords: Prevalence, Hepatitis C, Multitransfused Thalassemia Patients, Bangladesh

INTRODUCTION

The thalassaemias are inherited disorders of hemoglobin (Hb) synthesis. Their clinical severity widely varies, ranging from asymptomatic forms to severe or even fatal entities. The name Mediterranean anemia, which Whipple introduced, is misleading because the condition can be found in any part of the world. As described below, different types of thalassaemia are more prevalent to certain geographic regions [1]. World Health Organization (WHO) estimated that at least 6.5% of the world populations are carriers of different inherited disorders of hemoglobin [2]. Another WHO report estimated that 3% are carriers of multitransfused thalassaemia and 4% are carriers of Hb E in Bangladesh. In Bangladesh, more than 7000 children are born with thalassaemia each year [3]. Khan et al., [4] conducted a study on 687 Bengali school children, 4.1% of whom were carriers for beta thalassaemia trait. The carrier prevalence of beta thalassaemia trait in tribal children was 4.2%. The carrier status varies from country to country. The average beta thalassaemia carrier prevalence is 3.4% in Hong Kong, 5% in Pakistan, 3.3% in India and 3.1% in Tunisia [5,6,7,8]. In south east country, the carrier of trail were 30% in Cambodia, 35% in Lacs, 28% in 13 % in Mayanmur and 13% in Thailand [9]. In ß thalassaemia, the synthesis of normal a globin chains from the unaffected a globin genes continues as normal, resulting in the accumulation within the erythroid precursors of excess unmatched a globin. The free a globin chains are not able to form viable tetramers and instead precipitate in the red cell precursors in the bone marrow forming inclusion bodies. These a chain inclusion can be demonstrated by both light and electron microscopy in the erythroid precursors in the bone marrow as well as in the peripheral red cells following splenectomy. They are responsible for the extensive intramedullary destruction of the erythroid precursors and hence the ineffective erythropoiesis that underlies all thalassaemias [10]. Anemia in thalassaemia thus results from a combination of ineffective erythropoiesis, peripheral hemolysis, and an overall reduction in hemoglobin synthesis. The severity of disease in thalassaemia correlates well with the degree of imbalance between a and non-a globin chains and the size of the free a chain pool. Approximately 40% of thalassaemics have severe liver iron overload [11]. The prevalence of HCV infection among patients with BTM is estimated to be more than 60 % [12]. As life expectancy is prolonged beyond the third and fourth decade, the complications of chronic liver disease are likely to increase. Treatment of chronic HCV infection in thalassaemia patients with interferon-alpha (IFNA) and ribavirin is complicated by existing liver iron overload and the hemolytic effects of ribavirin. Conventional interferon is the first-used treatment with response rates at least as good as those in nonthalassaemics [13]. However, the addition of ribavirin was demonstrated to be beneficial in HCV genotype 1 infected patients, with the drawback of a median of 30-40% increase in transfusion needs [14]. Available data on survival in this population is scanty [15]. Although there is evidence concerning complications and mortality in patients with thalassaemia [16,17], the impact of HCV infection and antiviral treatment has not been assessed yet.

MATERIALS AND METHODS

Study design: Cross sectional study.

Place of study: Department of Paediatric Haematology and Oncology. Dhaka Shishu Hospital, Sher-e-Bangla Nagar, Dhaka, Bangladesh

Study period: February 2015 to August 2015.

Study population: The study population were children with multitransfused thalassaemic patient in the outpatient Department of Paediatric Haematology and Oncology of Dhaka Shishu Hospital, Dhaka, Bangladesh.

Sampling method: Purposive Sampling

Sample size: 60 children with multitransfused thalassaemia patients will be enrolled in this study.

Inclusion criteria:

i. Diagnosed cases of thalassaemia.
ii. Age between 4 - 18 years
iii. Multiple transfusions
iv. Positive for Anti HCV

Exclusion criteria:

i. Thalassaemic child known to be anti-HCV antibodies positive before starting blood transfusions
ii. Thalassaemic child born to anti-HCV antibody positive mother
iii. Thalassaemic child with past history of intravenous drug abuse involving syringe sharing.
iv. Pre existing liver disease or hepatitis
v. Not willing to participate in the study

Procedures of collecting data: After fulfillment of inclusion and exclusion criteria patient was enrolled in this study by giving an ID no. The subject will detailed about the study and informed consent will be taken. A checklist will be used for interviewing the parents, children and recording demographic information, physical examination and laboratory investigation like CBC, 2. Blood film, Serum bilirubin, SGPT, Prothrombin time, Serum Albumin, HBSAg, Anti HCV and USG of hepatic biliary system. The blood samples will be collected at under strict aseptic conditions and will be analyzed at the department of Pathology, by ELISA technique (ETI-AB-HCVK-4, DiaSorin, Italy).

Procedure of data analysis: Statistical analyses was carried out by using the Statistical Package for Social Sciences version 16.0 for Windows (SPSS Inc., Chicago, Illinois, USA). The mean values will be calculated for continuous variables. The quantitative observations will be indicated by frequencies and percentages. Chi-Square test with Yates correction will be used to analyze the categorical variables, shown with cross tabulation. Student t-test will be used for continuous variables. P values <0.05 will be considered as statistically significant.

RESULTS

Table 1: Characteristic of the study cases (n=60)

Characteristic of the study cases	Number of patients	Percentage
Age (in years)		
≤5	20	33.3
6-10	29	48.3
11-16	11	18.4
Mean±SD	7.4±3.09	
Range (min-max)	4,16	
Sex		
Male	36	60.0
Female	24	40.0
Socioeconomic condition		
Poor	11	18.3
Middle class	47	78.4
Rich	2	3.3

Table 1 shows the characteristic of the study cases. It was observed that 29(48.3%) patients belonged to age 6-10 years. The mean age was 7.4±3.09 years ranging from 4 to 16 years. Almost two third (60.0%) patients were male. More than three fourth (78.4%) patients came from middle class family.

Table 2: Clinical features of the study cases (n=60)

Clinical features	Number of patients	Percentage
Jaundice	39	65.0
Consanguinity	20	33.9
Abdominal pain	13	22
Nausea	8	13.6
Vomiting	2	3.3
Immunization	60	100.0
Hepatomegaly	40	66.7
Splenectomy	10	16.7
Mild hepatomegaly	3	5.0
Mild splenomegaly	1	1.7
Splenomegaly	1	1.7
Normal	5	8.3

Table 2 shows the clinical features of the study cases. It was observed that 60(100.0%) patients had immunization, 39(65.0%) patients had jaundice, 20(33.9%) patients had consanguinity, 13(22.0%) patients had abdominal pain, 8(13.6%) patients had nausea and 2(3.3%) patients had vomiting. Two third 40(66.7%) patients had hepntomegaly, followed by 10(16.7%) had Splenectomy. Mild splenomegaly and splenomegaly had 1(1.7%) respectively.

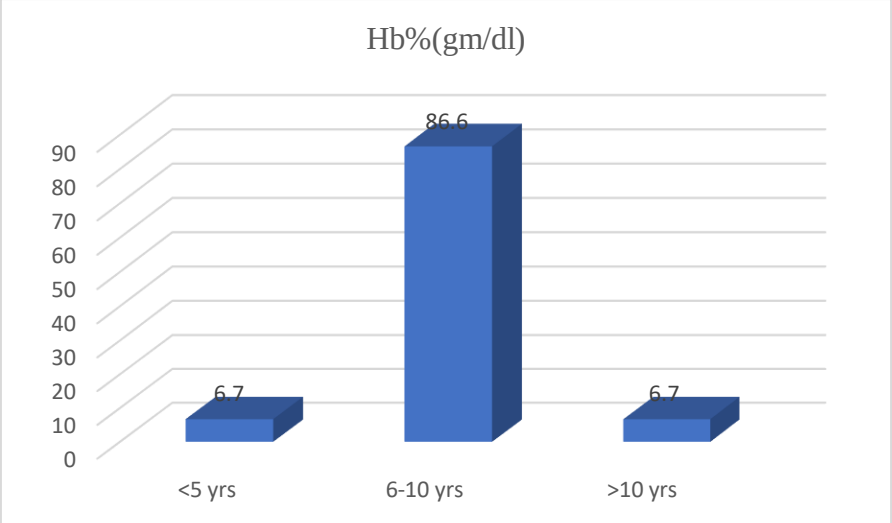

Figure 1: Pie chart shows Hb% distribution of the study patients

Table 3: Hematological and Biochemical parameters of patients (n=60)

Investigation	Mean±SD	Range
TC (cumm)	11614±13081	500,83000
Platelet count (cumm)	269424±149841	28000,706000
S.Bilirubin (mg/dl)	1.72±0.99	0.68,7.7
SGPT (U/L)	71.76±42.5	25,260
Prothrombin time (sec)	13.36±2.82	3,28
S.Albumin (gm/L)	49.0±55.09	22,448

Mean TC was 11614±13081 cumm with ranged from 500 to 83000 cumm. Mean platelet count was 269424±149841 cumm with ranged from 28000 to 706000 cumm. Mean S.bilirubin was 1.72±0.99 mg/dl with ranged from 0.68 to 7.7 mg/dl. Mean SGPT was 71.76±42.5 U/L with ranged from 25 to 260 U/L. Mean prothrombin time was 13.36±2.82 sec with ranged from 3 to 28. Mean S.albumin was49.0+55.09 gm/L with ranged from 22 to 448 gm/L.

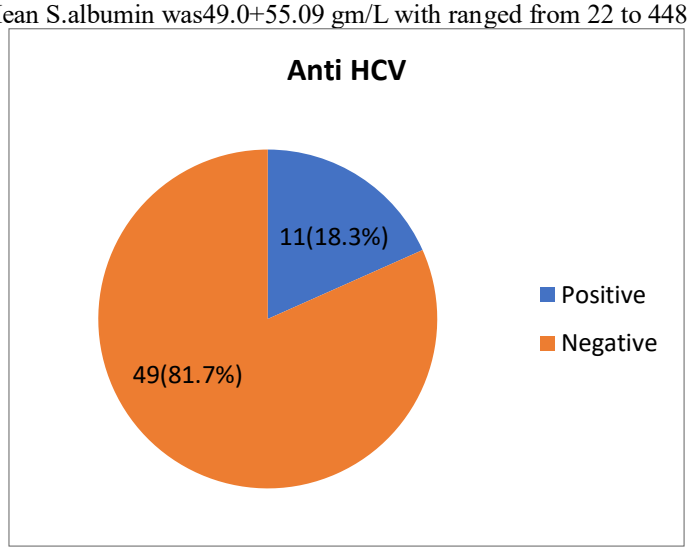

Figure 2: Pie chart shows anti HCV of the study patients

Pie chart shows anti HCV of the study patients, it was observed that 11(18.3%) patients had anti HCV.

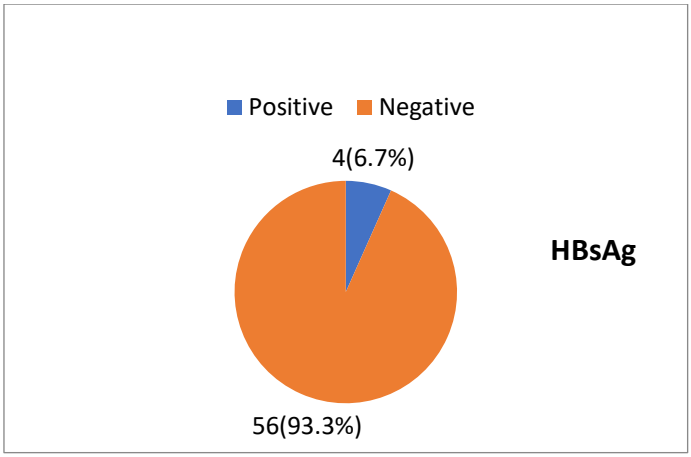

Figure 3: Pie chart shows HBsAg positive cases among the study patients

Table 4: Comparison between history and physical examination with anti HCV (n=60)

History and physical examination	Anti HCV				P value
	Positive (n=11)		Negative (n=49)		
	n	%	n	%	
Immunization	11	100.0	49	100.0	-
Jaundice	10	90.9	29	59.2	[a]0.043[s]
Consanguinity	5	45.5	15	30.6	[a]0.272[ns]
Abdominal pain	6	54.5	7	14.3	[a]0.008[s]
Nausea	2	18.2	6	12.2	[a]0.545[ns]
Vomiting	1	9.1	1	2.0	[a]0.335[ns]
	Mean±SD		Mean±SD		
Weight (kg)	24.6±8.8		15.8±5.5		[b]0.001[s]
Range (min, max)	12, 38		13,30		
Splenomegaly (cm)	13.9±2.7		9.6±5.2		[b]0.010[s]
Range (min, max)	10, 18		2,18		
Hepatomegaly (cm)	12.9±2.9		9.6±5.2		[b]0.035[s]
Range (min, max)	7,16		2,18		

s= significant, ns= not significant, [a]p value reached from chi square test, [b]p value reached from unpaired t-test

Table 4 shows history and physical examination with anti HCV of the study patients, it was observed 11 (100.0%) patients had immunization in anti HCV positive and 49(100.0%) in anti HCV negative, 10(90.9%) patients had jaundice in anti HCV positive and 29(59.2%) in anti HCV negative, 5(45.5%) patients had consanguinity in anti HCV positive and 15(30.6%) in anti HCV negative, 6(54.5%) patients had abdominal pain in anti HCV positive and 7(14.3%) in anti HCV negative, 1(9.1%) patients had vomiting in anti HCV positive and 1(2.0%) in anti HCV negative. The mean weight was 24.6±8.8 kg with ranged from 12 to 38 kg in positive group and 15.8±5.5 kg with ranged from 7 to 30 kg in negative group. Mean splenomegaly was 13.9±2.7 cm with ranged from 10 to 18 cm in positive group and 9.6±5.2 cm with ranged from 2 to 18 cm in negative group. Mean hepatomegaly was 12.9±2.9 cm with ranged from 7 to 16 cm in positive group and 9.4±5.2 cm with ranged from 2 to 18 cm in negative group. The difference was statistically significant (P<0.05) between two groups.

Table 5: Coexistence of HBsAg in patients with anti HCV (n=60)

HBsAg	Anti HCV				P value
	Positive(n=11)		Negative(n=49)		
	n	%	N	%	
Positive	0	0.0	4	8.2	0.434[ns]
Negative	11	100.0	45	91.8	

ns= not significant, p value reached from chi square test

Table 5 shows comparison between HBsAg with anti HCV of the study patients, it was observed that 4(8.2%) patients had HBsAg in negative group but not found in positive group. The difference was statistically not significant (P>0.05) between two groups.

Table 6: Comparison of Hematological and Biochemical parameters between anti HCV positive and anti HCV negative of the study patients (n=60)

Investigation	Anti HCV		P value
	Positive(n=11)	Negative(n=49)	
	Mean±SD	Mean±SD	
TC (cumm)	9118.2±6497.4	12167.8±14464.1	0.498^{ns}
Range (min, max)	3300, 22000	500, 83000	
Platelet count (cumm)	294363.6±98917.4	262111.1±158903.8	0.522^{ns}
Range (min, max)	134000, 415000	28000, 706000	
S.Bilirubin (mg/dl)	2.2±0.5	1.5±1.1	0.044^{s}
Range (min, max)	0.8, 2.2	0.7, 7.7	
SGPT (U/L)	88.2±82.4	67.1±26.8	0.137^{ns}
Range (min, max)	25,260	28, 148	
Prothrombin time (sec)	12.9±3.9	13.5±2.6	0.912^{ns}
Range (min, max)	3,17	12, 28	
S.Albumin (gm/L)	43.3±16.2	50.4±62.8	0.712^{ns}
Range (min, max)	29,84	22,448	

s= significant, ns= not significant, p value reached from unpaired t-test

Table 6 shows comparison of hematological and biochemical parameters between anti HCV positive and anti HCV negative of the study patients, it was observed that the mean TC was 9118.2±6497.4 cumm in positive group and 12167.8±14464.1 cumm in negative group. Mean platelet count was 294363.6+98917.4 cumm in positive group and 262111.1±158903.8 cumm in negative group. Mean S.bilirubin was 2.2±0.5 mg/dl in positive group and 1.5±1.1 mg/dl in negative group. Mean SGPT was 88.2+82.4 U/L in positive group and 67.1+26.8 U/L in negative group. Mean prothrombin time was 12.9±3.9 sec in positive group and 13.5±2.6 sec in negative group. Mean S.albumin was 43.3±16.2 gm/L in positive group and 50.4+62.8 gm/L in negative group. The mean S.bilirubin was statistically significant (P<0.05) between two groups.

DISCUSSION

In this current study was observed that 48.3% patients belonged to age 6-10 years. The mean age was 7.4±3.09 years ranging from 4 to 16 years. Bhavsar et al., [18] observed that the mean age was 6.65±3.68 years. In this present study, it was observed that 60.0% patients were male and 40.0% in female. Bhavsar et al.,[18] shows there were 65 (65.0%) males and 35 (35.0%) females. In this current study, it was observed that 78.4% patients came from Lower and upper -middle-income 81933.49-996218.63 class family. In this present study, it was observed that, 11(100.0%) patients had immunization in anti HCV positive and 49(100.0%) in anti HCV negative. Jaundice was found 90.9% in anti HCV positive and 59.2% in anti HCV negative. Consanguinity observed 45.5% in anti HCV positive and 30.6% in anti HCV negative. Abdominal pain was found 54.5% in anti HCV positive and 14.3% in anti HCV negative. Vomiting observed 9.1% in anti HCV positive and 2.0% in anti HCV negative. Jaundice and abdominal pain were significantly (P<0.05) higher in anti HCV positive cases. The mean weight was 24.6±8.8 kg with ranged from 12 to 38 kg in positive group and 15.8±+5.5 kg with ranged from 7 to 30 kg in negative group. Mean splenomegaly was 13.9±2.7 cm with ranged from 10 to 18 cm in positive group and 9.6±5.2 cm with ranged from 2 to 18 cm in negative group. Mean hepatomegaly was 12.9±2.9 cm with ranged from 7 to 16 cm in positive group and 9.4+5.2 cm with ranged from 2 to 18 cm in negative group. The mean weight, splenomegaly and hepatomegaly were significantly (P<0.05) higher in anti HCV positive cases. In Ain et al.,[19] study, total consanguinity rate among parents of thalassaemic children was 77.39%. Similar finding also observed by Baig et al., [20]. These findings are not in line with Al-Riyami and Ebrahim [21] reported 58 % total consanguinity in the Sultanate of Oman. In this current study, it was observed that, it was observed that 8.2% patients had HBsAg in negative group but not found in positive group. The difference was statistically not significant (P>0.05) between two groups. Vichinsky et al.,[22] observed 1.01% was HBsAg positive and 3.03% were anti HBC positive, which is comparable with the current study. In this present study, it was observed that, it was observed that the mean TC was 9118.2±6497.4 cumm in positive group and 12167.8±14464.1 cumm in negative group. Mean platelet count was 294363.6±98917.4 cumm in positive group and 262111.1±158903.8 cumm in negative group. Mean S.bilirubin was 2.2±0.5 mg/dl in positive group and 1.5±1.1 mg/dl in negative group. Mean SGPT was 88.2±82.4 U/L in positive group and 67.1±26.8 U/L in negative group. Mean prothrombin time was 12.9±3.9 sec in positive group and 13.5±2.6 sec in negative group. Mean S.albumin was 43.3±16.2 gm/L in positive group and 50.4±62.8 gm/L in negative group. The mean S.bilirubin was significantly (P<0.05) higher in anti HCV positive cases.

CONCLUSION

Prevalence of Hepatitis C virus infection in multitransfused Thalassemia patients is common (18.3%) in Tertiary care Hospital (Dhaka Shishu Hospital).

Limitations of the study

1. The study population was selected from one selected hospital in Dhaka city, so that the results of the study may not have reflected the exact picture of the country.
2. Small sample size was also a limitation of the present study. Therefore, in future further study may be under taken with large sample size.

Recommendation

An effective strategy of preventing the progression of the disease in Bangladesh might be a nationwide screening program employing more sophisticated techniques like polymerase chain reaction (PCR) followed by direct sequencing, genetic counseling, and creating public awareness. Further studies can be undertaken by including large number of patients.

REFERENCE

1. Yaish HM, Coppes MJ. Pediatric Thalassaemia. http://emedicine.medscape.com/article/958850-differential (Accessed on 2013).
2. Modell B, (1995). 'Update to epidemiology of hemoglobin disorders with special references to thalassaemia'. Thalassaemia International Federation. International Transfusion Medicine, vol. 5, pp.247-58.
3. Khan WA (2006). 'Prevention is the only way to combat thalassaemia'. The Daily Star, vol. 5(576).
4. Khan WA, Banu B, Amin SK, Selimuzzaman M, Rahman M and Hossain B et al., (2005). 'Prevalence of beta thalassaemia trait and Hb E trait in Bangladeshi school children and health burden of thalassaemia in our population'. Dhaka Shishu Hospital Journal, vol. 21(1), pp.1-7.
5. Saboo SS, Krajewski KM, O'regan KN, Giardino A, Brown JR and Ramaiya N et al., (2012). 'Spleen in haematological malignancies: spectrum of imaging findings'. The British Journal of Radiology, vol. 85(1009), pp.81-92. Statistical year book of Bangladesh, 23rd edition (2002).
6. Khattak MF and Saleem M (1992). 'Prevalence of heterozygous b-thalassaemia in the northern areas of Pakistan'. Journal of Pakistan Medical Association, vol. 42, pp.32- 4.
7. Ambekar SS, Phadke MA, Mokashi GD, Bankar MP, Khedkar VA and Venkat V, et al., (2001). 'Pattern of hemoglobinopathies in western Maharashtra'. Indian Pediatrics, vol. 38(5), pp.530-534.
8. Mseddi S, Gargouri J, Labiadh Z, Kassis M, Elloumi M and Ghali L et al. (1999). 'Prevalence of hemoglobin abnormalities in Kebili (Tunisian South)'. Revue d'epidemiologie et de sante publique, vol. 47(1), pp.29-36.
9. Chakravarti A, Verma V, Kumaria R and Dubey AP, (2005). 'Anti-HCV seropositivity among multiple transfused patients with beta thalassaemia'. Journal of Indian Medical Association, vol. 103(2), pp.64-66.
10. Thein SL (2005). 'Pathophysiology of ß thalassemia-A guide to molecular therapies'. ASH Education Program Book, vol. 2005(1), pp.31-37.
11. Perifanis V, Tziomalos K, Tsatra I, Karyda S, Patsiaoura, K. and Athanassiou-Metaxa M (2005). 'Prevalence and severity of liver disease in patients with b thalassaemia major. A single-institution fifteen-year experience. Haematologica, vol.90(8), pp. 1136-1138.
12. Di Marco V, Capra M, Angelucci E, Borgna-Pignatti C, Telfer P And Harmatz P, et al., (2010). 'Management of chronic viral hepatitis in patients with thalassaemia: recommendations from an international panel'. Blood, vol. 116(16), pp.2875-2883.
13. Di Marco V, lacono OL, Almasio P, Ciaccio C, Capra M and Rizzo M et al., (1997). 'Long-term efficacy of a-Interferon in B-thalassaemics with chronic hepatitis C'. Blood, vol. 90(6), pp.2207-2212.
14. Alavian SM and Tabatabaei SV (2010). "Treatment of chronic hepatitis C in polytransfused thalassaemic patients: a meta-analysis'. Journal of Viral Hepatitis, vol.17(4), pp.236-244.
15. Mirmomen S, Ebrahimi Daryani N, Malekzadeh R, Zali MR, Haghpanah B and Poursamimi P (2004). 'The efficacy and safety of peginterferon alpha-2a (PEGASYS) monotherapy in the treatment of chronic hepatitis C infected subjects with transfusion dependent thalassaemia'. Hepatitis Monthly, vol. 4(7), pp.65-70.
16. Ladis V, Chouliaras G, Berdoukas V, Chatziliami A, Fragodimitri C and Karabatsos F et al., (2011). 'Survival in a large cohort of Greek patients with transfusion - dependent beta thalassaemia and mortality ratios compared to the general population'. European Journal of Haematology, vol. 86(4), pp.332-338.
17. Cao A (2004). 'Quality of life and survival of patients with beta-thalassaemia major'. Haematologica, vol. 89(10), pp. 1157-1159.
18. Vichinsky E, Levine L, Bhatia S, Bojanowski J, Coates T and Foote D et al., (2008). 'Standards of care guidelines for thalassaemia'. Children's Hospital & Research Center Oakland, USA.
19. Ain ALQ, Hassan M, Rana, SM and Jabeen F (2011). 'Prevalence of ß-thalassaemic patients associated with consanguinity and anti-HCV-antibody positivity-a cross-sectional study'. Pakistan Journal of Zoology, vol. 43(1), pp.29-36.
20. Baig SM, Rabbi F, Hameed U, Qureshi JA, Mahmood Z and Bokhari SH, et al., (2005). 'Molecular characterization of mutations causing ß-thalassaemia in Faisalabad Pakistan using the amplification refractory mutation system (ARMS-PCR)'. Indian Journal of Human Genetics, vol.11(2), p.80.

21. Al-Riyami A and Ebrahim GJ (2003). 'Genetic blood disorders survey in the Sultanate of Oman'. Journal of Tropical Pediatrics, p.49.
22. Vichinsky E, Levine L, Bhatia S, Bojanowski J, Coates T and Foote D et al., (2008). 'Standards of care guidelines for thalassaemia'. Children's Hospital & Research Center Oakland, USA.