The Influence of Decreased Levels of High Density Lipoprotein Cholesterol on Hematological Indices in Sickle Cell Disease Patients

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Abstract

Background: Changes in lipoproteins levels in sickle cell disease (SCD) patients are well-known, but the physiological ramifications of the low levels observed have not been entirely resolved. **Aim:** The aim of this study is to evaluate the impact of decreased levels of high density lipoprotein cholesterol (HDL-c) on hematological indices in steady state SCD patients. **Subjects and Methods:** The study was conducted on 84 SCD patients on steady clinical state, 36 males and 48 females with a mean age 21 (6) years. All those who have had blood transfusion within 4 months, infection, chronic kidney disease, and inflammatory episodes were excluded. Full blood count, total cholesterol, HDL-c, low density lipoprotein cholesterol, very low density lipoprotein cholesterol, and triglyceride were assayed. Hematological indices of SCD patients with decreased levels of HDL-c were compared with those with normal HDL-c levels. **Results:** The SCD patients with decreased levels of HDL-c presented with lower levels of hemoglobin ($P < 0.01$), hematocrit ($P < 0.001$), total leukocyte count ($P = 0.02$), red blood cell count ($P < 0.01$), absolute neutrophil count ($P = 0.04$), absolute monocyte count ($P < 0.01$), and triglyceride ($P = 0.02$).Of the 47 SCD with decreased levels of HDL-c, 82.9% (39/47) have had blood transfusion while 48.6% (18/37) out of 37 SCD with normal HDL-c have had blood transfusion. **Conclusion:** SCD patients with decreased levels of HDL-c had more severe anemia, higher leukocyte and platelet counts than those with normal HDL-c levels. The low HDL-c marker may assist in the prediction of adverse clinical events in these patients.

Keywords: Blood transfusion, Hematological indices, High density lipoprotein cholesterol, Sickle cell disease

Introduction

Sickle cell disease (SCD) is an inherited hemolytic anemia with a variable course and severity. The knowledge of prognosis biomarkers may help in the establishment of therapeutic intervention, management, and follow-up of patients. Studies have shown associations between some laboratory parameters and the clinical events predicting prognosis of the SCD.[1,2] Some of the well-known biomarkers that predict SCD clinical prognosis includes fetal hemoglobin, leukocyte counts, and serum Lactate dehydrogenase.[2-4] Other factors that may predict the risk of complications and death in SCD patients are vaso-occlusive episodes resulting from a complex interaction of events with participation of stressed reticulocytes, sickled red blood cells, leukocytes, platelets, and endothelial activation.[5,6] Bacterial infection associated with leukocytosis, malaria, dehydration, extremes of temperatures, stress, and low oxygen tension have all been shown to precipitate sickle cell crises and consequent adverse clinical outcome.

Even though, decreased levels of cholesterol and lipoprotein in SCD patients are well-documented, the pathophysiological implications of these changes have not been completely resolved.[1] In our previous report, it was observed that the levels of high density lipoprotein cholesterol (HDL-c) in SCD patients were lower (≤0.8 mmol/L) than normal and that

some of the values were within normal limits (≥0.8 mmol/L)[3] probably related to the severity of anemia. Furthermore, lipid profile of SCD patients was different from that of subjects with normal hemoglobin and Nigerian SCD patients were reported to have lower lipid profile levels compared to their counterparts in America and Middle East.[3,4] The variations have been attributed to differences in age, diet, weight, smoking, disease severity, and treatment regimen.[5,7]

In this study, we evaluated the impact of decreased levels of HDL-c on hematological indices, which has been postulated to predispose SCD patients to severe hemolysis and hence anemia and its association with other hematological parameters in steady state patients.

Subjects and Methods

This was a prospective hospital based cross-sectional study in which 84 consecutive SCD patients aged 15 years and above attending the adult hematology clinic of Aminu Kano Teaching Hospital, Kano was recruited from January 2007 to December 2007. SCD patients with chronic kidney disease and other chronic complications were excluded from the study. Approval for the study was obtained from the ethical review board of the hospital, and written informed consent was signed by the patients or their parents. Clinical and demographic data were documented and only those patients with steady clinical state of the disease were included. Steady clinical state was defined as a period without any acute events and no blood transfusion for about 4 months prior to blood sample collection. A total of 56 subjects who have had blood transfusion within 4 months, infection and inflammatory episodes were excluded.

A total of 5 mL of fasting blood samples were collected with 2 mL each dispensed into the tube containing ethylene diamine tetra acetic acid anticoagulant for full blood count and the remaining 3 mL was emptied into plain container. This was allowed to clot at room temperature and then centrifuged at 3000 rpm for 10 min to obtain serum. The full blood count was carried out using electronic cell counter, Coulter CELL DYE 3700 auto-analyzer (Coulter Corporation, USA). The total cholesterol and triglyceride were determined using the enzyme catalyzed colorimetric technique by Randox Laboratories, UK while HDL-c was assayed using the supernatant after precipitation with magnesium chloride-phosphotungstic acid solution. The low density lipoprotein cholesterol (LDL-c) was calculated using the Friedewald formula.[8]

Statistical analysis

A two sample unpaired t-test was used to determine the statistical significance of the means between groups. A $P \leq 0.05$ was considered statistically significant. Bivariate correlation analyses were carried out to determine the correlation between HDL-c and other measured variables using Pearson's correlation (r). Data analyses were performed using SPSS version 16.0 (Chicago, IL, USA).

Results

The results are as shown in Tables 1-3. Table 1 shows the association of HDL-c with the measured parameters. HDL-c correlated positively with the red blood cell count ($P < 0.01$), absolute lymphocyte count ($P < 0.001$) and negatively with LDL-c ($P < 0.001$). While the other parameters showed no significant association with HDL-c.

Table 2 indicates the comparison of measured parameters in SCD patients with HDL-c levels (decrease (<0.8 mmol/L) and normal HDL-c (≥0.8 mmol/L). There were 47 patients with HDL-c < 0.8 mmol/L and 37 with HDL-c ≥ 0.8 mmol/L.

Table 1: Association of HDL-cholesterol with hematological indices and lipoproteins levels in SCD patients		
Hematological Indices and lipoproteins	HDL cholesterol (mmol/L) R	P value
Hematological indices		
Hemoglobin (g/dL)	−0.137	P=0.06
Hematocrit (%)	0.059	P=0.06
Total leukocyte count (×10⁹/L)	−0.020	P=0.06
Red blood cell count (×10⁹/L)	0.293	P<0.001
Platelet count (×10⁹/L)	0.002	P=0.06
Mean cell hemoglobin (pg)	−0.023	P=0.06
Mean cell volume (fL)	0.061	P=0.06
Mean cell hemoglobin conc (g/dL)	−0.135	P=0.06
Absolute lymphocyte count (×10⁹/L)	0.360	P<0.001
Absolute neutrophil count (×10⁹/L)	−0.032	P=0.06
Absolute eosinophil count (×10⁹/L)	−0.002	P=0.06
Lipid profile		
Total cholesterol (mmol/L)	0.079	P=0.06
LDL-cholesterol (mmol/L)	−0.502	P<0.001
VLDL-cholesterol (mmol/L)	−0.082	P=0.06
Triglyceride (mmol/L)	0.078	P=0.06

HDL-C: High density lipoprotein cholesterol, SCD: Sickle cell disease, LDL-C: Low density lipoprotein, VLDL-C: Very low density lipoprotein

Table 2: Comparison of hematological indices and lipid profile between SCD patients with low and normal serum HDL-C concentrations (mean [SEM])

Measured parameters	HDL-C (<0.8 mmol/L)	HDL-C (>0.8 mmol/L)	*P* value
Number of subjects	47	37	
Hematological indices			
Hemoglobin (g/dL)	7.3 (0.06)	7.4 (0.03)	*P*<0.01
Hematocrit (%)	19.6 (1.6)	20.5 (0.08)	*P*<0.001
Total leukocyte count (×10⁹/L)	11.4 (0.2)	10.9 (0.2)	*P*=0.02
Red blood cell count (×10⁹/L)	2.30 (0.2)	2.51 (0.06)	*P*<0.01
Platelet count (×10⁹/L)	389 (9.0)	364 (3.0)	*P*<0.001
Mean cell hemoglobin (pg)	28.2 (1.8)	29.2 (2.0)	*P*=0.06
Mean cell volume (fL)	78.9 (4.8)	80.2 (5.0)	*P*=0.06
Mean cell hemoglobin conc (g/dL)	35.2 (1.8)	36.1 (2.0)	*P*=0.06
Absolute lymphocyte count (×10⁹/L)	3.5 (0.2)	3.8 (0.3)	*P*=0.06
Absolute neutrophil count (×10⁹/L)	4.41 (0.6)	5.3 (0.4)	*P*=0.04
Absolute monocyte count (×10⁹/L)	0.5 (0.1)	0.8 (0.1)	*P*<0.01
Absolute eosinophil count (×10⁹/L)	0.2 (0.1)	0.2 (0.1)	*P*=0.90
Lipid profile			
Total cholesterol (mmol/L)	3.3 (0.1)	3.4 (0.1)	*P*=0.06
LDL-cholesterol (mmol/L)	2.1 (0.1)	1.9 (0.1)	*P*=0.06
VLDL-cholesterol (mmol/L)	0.42 (0.06)	0.41 (0.05)	*P*=0.07
Triglyceride (mmol/L)	1.1 (0.09)	1.61 (0.2)	*P*=0.02

HDL-C: High density lipoprotein cholesterol, LDL-C: Low density lipoprotein cholesterol, VLDL: Very low density lipoprotein cholesterol

Table 3: HDL-cholesterol levels based on SCD severity

Clinical quantitative indices	Severe (%)	Moderate-mild (%)
Number of patients	44 (100)	40 (100)
Number of males	14 (31.8)	22 (55)
Number of females	30 (68.2)	18 (45)
Body mass index	18.7(1.6)	17.1(1.5)
Number of crisis per year	≥5	≤4
Number of patients who had been transfused	37 (84)	18 (45)
Number of times blood was transfused	≥3	≤2
Number of patients who had never received blood transfusion	07 (16)	22 (55)
Number of patients who take analgesic	44 (100)	40 (100)
Number of patients with decreased HDL-C concentration (<0.8 mmol/L)	31 (70.5)	16 (40)
Number of patients with high HDL-C concentration (≥0.8 mmol/L)	13 (29.5)	24 (60)

HDL-C: High density lipoprotein cholesterol, SCD: Sickle cell disease

Those with decreased levels of HDL-c presented with lower levels of hemoglobin ($P < 0.01$), hematocrit ($P < 0.001$), total leukocyte count ($P = 0.02$), red blood cell count ($P < 0.01$), absolute neutrophil count ($P = 0.04$), absolute monocyte count ($P < 0.01$), and triglyceride ($P = 0.02$).In addition, out of the 47 SCD patients with decreased HDL-c levels, 82.9% (39/47) had been transfused with blood while 48.6% (18/37) of the SCD patients with normal HDL-c had received blood transfusion in the past. There was however no record of the number of units of blood received by the patients.

Table 3 shows HDL-c levels based on SCD severity of the study group. patients were grouped into severe and moderate-mild disease based on markers of disease severity, which include age of patients at diagnosis, numbers of hospitalization, numbers and types of crisis, presence or absence of Pneumococcal infection, major organs involvement, and number of times blood transfusion was received. From the data, all the SCD patients were diagnosed at childhood and none had symptoms of organ involvement or Pneumococcal infection. A total of 44 SCD patients were classified as severe while 40 were grouped under moderate-mild disease severity. The severe group had a vaso-occlusive crisis ≥ 5 times/year, 84% (37/44) of the patients had received blood transfusion at least 3 times in their life time while 16% (07/44) had never received blood transfusion. Among the severe group, 70.5% (31/44) of the patients had decreased (<0.8 mmol/L) HDL-c while 29.5% (13/44) had normal (≥0.8 mmol/L) HDL-c levels. On the other hand, the moderate-mild group had a vaso-occlusive crisis less than 4 times in a year and 45% (18/40) of them had

received blood transfusion at least 2 times in their life time. Twenty two (55%) had never received blood transfusion, 40% (16/40) had decreased (<0.8 mmol/L) HDL-c and 60% (24/40) had normal (>0.8 mmol/L) HDL-c levels. The record of a number of hospitalizations was not available.

Discussion

The data presented indicated that SCD patients with decreased HDL-c (<0.08 mmol/L) had lower levels of markers of hemolysis (anemia), absolute neutrophil, monocyte count, total cholesterol, and triglyceride while platelet count was significantly higher than those with normal HDL-c levels (≥0.8 mmol/L) as was previously reported.[1,6,9] SCD patients with decreased HDL-c levels presented with higher risk of hemolysis and anemia,[10] which may be related to high consumption of cholesterol due to increased erythropoietic activities of the bone marrow cells during hemolytic crisis. It is proposed that therapeutic intervention aimed at increasing the levels of HDL-c in these patients may improve patients' outcome.

About 84% (37/44) of our study patients with decreased HDL-c had received a blood transfusion as against 45% (18/40) of those with normal HDL-c levels. This observation agreed with Ohene-Frempong and Steinberg[11] who reported that SCD patients with decreased HDL-c levels are likely to have more blood transfusion than those with normal HDL-c levels. This may be an indication of poor prognosis though, transfusion is a therapeutic regimen used to prevent several clinical symptoms in these patients, repeated transfusions have been shown to increase other long-term complications such as alloimmunization, iron overload, graft versus host disease, infections to mention a few.

Our data indicated that markers of anemia and total cholesterol were significantly lower in SCD patients with decreased HDL-c levels compared to those with normal HDL-c levels. This is also consistent with that of Zorcas *et al*.[1] who reported that low lipoprotein levels in SCD were associated with severity of anemia while increased triglyceride level was associated with hemolysis, vascular dysfunction, and increased prevalence of pulmonary hypertension.

The decreased levels of HDL-c in SCD may reduce its anti-inflammatory and anti-oxidative functions.[6] The function of HDL-c does not only includes reverse-cholesterol transport, but modulation of inflammation. In healthy individuals, in the absence of systemic oxidative stress and inflammation, HDL is anti-inflammatory.[12-14] HDL-c is capable of preventing LDL-c oxidation and inflammatory response induced by LDL-c deposition in the endothelial space where the oxidized LDL-c caused the cells to synthesize and secrete monocyte chemoattractant protein-1; which is a potent inflammatory agent as seen in atherosclerosis.[15] The HDL consists of several particles of different compositions and functions.[12,13]

One of such components of HDL is the Lecithin: Cholesterol Acyltransferase; an important enzyme involved in the esterification of cholesterol which had earlier been reported to be low in SCD patients.[14]

The hematological indices in SCD patients with decreased HDL-c are different from those with normal HDL-c levels. In this study, more of the SCD patients with decreased HDL-c had a higher frequency of vaso-occlusive crisis compared to those with normal HDL-c levels. Increase in leukocyte count was also observed in SCD patients with decreased HDL-c compared to those with normal HDL-c, which may be associated with bacterial infection since bacterial infection in SCD patients is a predisposing factor to crisis. Many other complications of SCD such as pain, silent infarction, stroke, and acute chest syndrome are associated with leukocytosis.[16]

The increased platelet counts observed in patients with decreased HDL-c may be due to factors such as auto-splenectomy resulting from recurrent splenic vessels occlusion, which may be predominant in this group compared to those with normal HDL-c levels. In addition, the increased platelet counts observed in these patients with decreased HDL-c may lead to platelet aggregation in areas of stasis during the vaso-occlusive crisis. The Spleen in normal subjects has been shown to retain newly formed platelets for up to 2 days before release. These young and more biologically active platelets show greater responsiveness in platelet function tests. Thus, the increased platelet counts in SCD patients in steady state may reflects the absence of splenic pooling of young active platelets rather than chronic intravascular activation of platelets in the micro-circulation.[15,16] Others also attributed the increase to a negative feedback effect on erythropoietin production in SCD patients due to anemia because erythropoietin has a structural homology with thrombopoietin, even though thrombopoietin has an identity with or similarity to erythropoietin at the N-terminal region.[17]

Conclusion

Decreased HDL-c levels in SCD patients appears to portend severe anemia, higher leukocyte and platelet counts and may predict adverse clinical course and thus, this group of patients may likely benefit from more frequent evaluation. More studies are however, required to ascertain whether this indicates the use chronic transfusion therapy and/or hydroxyurea in order to prevent or delay development of complications.

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Knowledge of First Aid Skills Among Students of a Medical College in Mangalore City of South India

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Abstract

Background: The adequate knowledge required for handling an emergency without hospital setting at the site of the accident or emergency may not be sufficient as most medical schools do not have formal first aid training in the teaching curriculum. **Aim:** The aim of this study is to assess the level of knowledge of medical students in providing first aid care. **Subjects and Methods:** This cross-sectional study was conducted during May 2011 among 152 medical students. Data was collected using a self-administered questionnaire. Based on the scores obtained in each condition requiring first aid, the overall knowledge was graded as good, moderate and poor. **Results:** Only 11.2% (17/152) of the total student participants had previous exposure to first aid training. Good knowledge about first aid was observed in 13.8% (21/152), moderate knowledge in 68.4% (104/152) and poor knowledge in 17.8% (27/152) participants. Analysis of knowledge about first aid management in select conditions found that 21% (32/152) had poor knowledge regarding first aid management for shock and for gastro esophageal reflux disease and 20.4% (31/152) for epistaxis and foreign body in eyes. All students felt that first aid skills need to be taught from the school level onwards and all of them were willing to enroll in any formal first aid training sessions. **Conclusion:** The level of knowledge about first aid was not good among majority of the students. The study also identified the key areas in which first aid knowledge was lacking. There is thus a need for formal first aid training to be introduced in the medical curriculum.

Keywords: First aid skills, Knowledge, Medical students

Introduction

First aid is applied to injured or ill persons in any health threatening settings in order to save life, prevent degradation of the situation or contribute to a treatment process before professional medical care is available. This refers to assessments and interventions that can be performed by a bystander (or by the victim) with minimal or no medical equipment.[1]

At some point in a medical curriculum students are taught how to handle emergencies in a hospital emergency setting where drugs and other necessities are available. However, the adequate knowledge required for handling an emergency without hospital setting at the site of the accident or emergency may not be sufficient.[2,3]

Studies have found that the knowledge of first aid amongst medical students has always been a neglected subject. Hence, it should not be surprising to note that even junior doctors at certain hospitals cannot perform the first aid skills satisfactorily.[4]

As the incidence of medical emergencies are on the rise in recent years it is important to ensure that health personnel are adequately trained to deal with such events.[5,6] Very few studies have been performed about knowledge of first aid skills among medical students in India.

The objectives of this study were thus to assess the level of knowledge of undergraduate students in providing first aid care,

to identify the emergencies where there is a lack of knowledge of first aid and to assess the student's opinion regarding the need for first aid training at medical colleges.

Subjects and Methods

This cross-sectional study was performed in May 2011 in a private medical college in Mangalore city of south India. The ethical approval for conducting this study was obtained from institutional ethics committee. The target sample size was 177, based on the assumption of knowledge about first aid practices among medical students to be 50%, 95% confidence interval and relative precision of 20%. A total of 77 students were chosen from the fourth semester and 50 each from sixth to eighth semester in accordance to the probability proportional to the size/strength of the class. The criterion for selecting semesters was based on the exposure of students to clinical settings during these semesters. The required number of students in each semester was selected by simple random sampling method.

The students were briefed about the objective of the study and their informed consent was taken for participation. A self-administered anonymous multiple choice questionnaire was used for data collection to assess the knowledge of students regarding administration of first aid in different situations. The questionnaire was pre-tested earlier on a group of 10 house surgeons posted in the department of community medicine and based on their responses questions were modified before it was distributed in its final form to the participants. Reliability of the questionnaire was assessed using Cronbach's Alpha value of which was 0.86 indicating good internal consistency.

The questions on management of common first aid emergencies such as unconsciousness, heat burns, external bleeding, epistaxis, heat stroke, drowning, shock, choking, electrocution, seizures, poisoning, animal bites, frost bite, foreign body in ears and eyes, anginal pain, heart burn, fractures and dislocations were asked. Few questions were developed in the form of scenarios depicting real life situations and covered all the essential aspects of first aid. The face validity of this questionnaire was performed by experts in clinical specialties such as ENT, Ophthalmology, Surgery and Internal Medicine. Each first aid management option was given weighted marks based on the appropriateness of that intervention for that particular condition. This was to bring out the preferred responses of the students to various emergency situations.

The maximum possible score which could be obtained was 207 and minimum being 7. Summation of the scores allotted to the most essential first aid management options for each medical emergency formed the basis of categorization of overall knowledge of students about first aid. The accumulation of points allotted to must know responses was used for deciding the cut-off score for poor performance. Similarly, the cut-off value for moderate performance was based on the

cumulative points allotted to nice to know responses made less from the maximum score of 207. The score between 147 and 207 was considered as good, 67-146 as moderate and 7-66 as poor knowledge about first aid. The incompletely filled questionnaires were excluded from the analysis.

The data entry and analysis was performed using Statistical Package for Social Sciences software package (SPSS Inc., Chicago, IL, USA) version 17. Chi-square test was used to find out the association of socio demographic variables with the level of knowledge regarding first aid and $P < 0.05$ was taken as statistically significant association.

Results

A total of 152 fully completed questionnaires were received with a response rate of 85.9%. Of the 152 students, 77 were from fourth semester, 39 from sixth, and 36 from eighth semester.

Most students 26.3% (40/152) were of the age group 20-21 years with a mean age of 20.82 (1.4) years. Age of students ranged from 18 years to 24 years. Most of them were males 59.9% (91/152) and most of them were students of the fourth semester 50.7% (77/152). Only 11.2% (17/152) students had previously exposure to first aid training. Of the total participants, 13.8% (21/152) students had good, 68.4% (104/152) had moderate and 17.8% (27/152) had poor level of knowledge about first aid.

There was no association of gender or previous training in first aid skills with the level of current knowledge about first aid among the participants. Students of the eighth semester had significantly better knowledge about first aid compared to fourth and sixth semester students ($P = 0.04$) [Table 1].

With respect to awareness of first aid measures in various conditions, 21% (32/152) had poor knowledge of first aid procedures in shock and gastro esophageal reflux disease (GERD). This was followed by poor knowledge of first aid procedures in management of epistaxis and foreign body in eyes 20.4% (31/152) [Table 2]. All students felt that they have to be competent in first aid skills and said that they will not hesitate in applying it in various emergencies in real life situations. All felt that these skills need to be taught from the school level onwards and all of them were willing to enroll for any formal first aid training sessions at the medical college.

Discussion

In the present study very few students had good knowledge about first aid and this was not influenced with whether the student was previously trained or not in first aid procedures. Similarly, a Peruvian study reported that in spite of 52.5% medical students having had prior training in management of medical

Table 1: Association of gender, semester of study and previous exposure to first aid training with knowledge of first aid skills

Characteristics	Good knowledge (%)	Moderate knowledge (%)	Poor knowledge (%)	Total
Gender				
Male	7 (11.5)	42 (68.8)	12 (19.7)	61
Female	14 (15.4)	62 (68.1)	15 (16.5)	91
			χ^2=0.616, *P*=0.74	
Semester				
Fourth	12 (15.6)	50 (64.9)	15 (19.5)	77
Sixth	3 (7.7)	25 (64.1)	11 (28.2)	39
Eighth	6 (16.7)	29 (80.5)	1 (2.8)	36
			χ^2=9.535, *P*=0.04	
Previous exposure in first aid training				
Yes	5 (29.4)	8 (47.1)	4 (23.5)	17
No	16 (11.9)	96 (71.1)	23 (17)	135
			χ^2=5.0, *P*=0.08	
Total	21	104	27	152

Table 2: Distribution of students based on their knowledge in each aspect of first aid management in different emergency conditions

Aspects of first aid management	Good knowledge	Moderate knowledge	Poor knowledge	Total
Definition of first aid	20 (13.2)	102 (67.1)	30 (19.7)	152
Purpose of first aid	24 (15.8)	100 (65.8)	28 (18.4)	152
First aid in road traffic accidents	19 (12.5)	111 (73)	22 (14.5)	152
First aid in snake bites	23 (15.1)	100 (65.8)	29 (19.1)	152
First aid in syncope attacks	22 (14.5)	106 (69.7)	24 (15.8)	152
First aid in burns	21 (13.8)	105 (69.1)	26 (17.1)	152
First aid in bleeding wounds	20 (13.2)	109 (71.7)	23 (15.1)	152
First aid in epistaxis	21 (13.8)	100 (65.8)	31 (20.4)	152
First aid in heat stroke	18 (11.8)	109 (71.7)	25 (16.5)	152
First aid in hypovolemic shock	24 (15.8)	96 (63.2)	32 (21)	152
First aid following choking by foreign body	20 (13.2)	102 (67.1)	30 (19.7)	152
First aid in electric shock	23 (15.1)	107 (70.4)	22 (14.5)	152
First aid in seizures	21 (13.8)	103 (67.8)	28 (18.4)	152
First aid in poisoning	24 (15.8)	103 (67.8)	25 (16.4)	152
First aid in drowning	22 (14.5)	101 (66.4)	29 (19.1)	152
First aid in animal bites	19 (12.5)	109 (71.7)	24 (15.8)	152
First aid in frost bite	22 (14.5)	103 (67.7)	27 (17.8)	152
First aid in foreign body in ears	19 (12.5)	110 (72.4)	23 (15.1)	152
First aid in foreign body in eyes	23 (15.1)	98 (64.5)	31 (20.4)	152
First aid in anginal pain	18 (11.8)	108 (71.1)	26 (17.1)	152
First aid in gastroesophageal reflux disease	18 (11.8)	102 (67.1)	32 (21.1)	152
Overall knowledge	21 (13.8)	104 (68.4)	27 (17.8)	152

emergencies, 60.4% had poor knowledge about first aid.[7] A Dutch study reported 81% of junior doctors to be having poor knowledge about first aid.[4] A study conducted in Lucknow, India showed that there was less than adequate knowledge (52%) and practices (54%) in all groups of participants (resident doctors, hospital consultants, and private practitioners).[8]

This meant that, not only is first aid training required at medical colleges it has to be reinforced periodically with refresher training workshops in first aid. Only a Karachi based study found that 63.2% medical students had good, 28.3% moderate and 8.3% poor knowledge about first aid, which was better than our observations.[2]

In the present study, females had slightly better knowledge about first aid than males, which was similar to the findings of a study performed in Karachi.[2] The Peruvian study found a significant association between knowledge about first aid and female gender.[7] Senior students in this study had significantly better knowledge about first aid compared to juniors, which was similar to findings of other studies.[7,9] Most students in this study had poor knowledge regarding first aid management in shock, GERD, epistaxis and foreign body removal from the eyes.

In this study, only 14.5% students knew correctly the steps of cardio pulmonary resuscitation (CPR) as a part of first

aid management in drowning cases, which was similar to the findings of a study performed in Salem, Tamil Nadu where it was seen among 17.1% of medical students.[10] In the Dutch study too only 6% of the students knew and performed correct CPR.[4] However, two Karachi based studies reported that 32.2% and 38.8% participants knew how to correctly perform CPR, which was better than our observations.[2,11] The knowledge of first aid management in suspected fractures by immobilization and in bleeding by part elevation and pressure bandage in road traffic accidents was good in about 44% students in two studies done at Karachi[2,11] and 82.7% in a Peruvian study,[7] which was again better than our observations (12.5%). The first aid management of burns was known correctly only by 13.8% students as against 23.2% in an Irish study.[12] First aid following accidental choking by a foreign body was good in only 13.2% cases as against 43.6% cases in the Karachi based study[11] and 53.4% in the Peruvian study[7] where students knew of measures like stroking between shoulder blades or of Heimlich maneuver by hitting the chest.

With respect to correct management of convulsions, 24.8% medical students in the Karachi study knew of recovery position to avoid any aspiration and tongue rolling as against 13.8% students in our study.[11] The former study also reported that 30.4% medical students had good knowledge of first aid management in cases of accidentally ingestion of poisons as against 15.8% in our study.[11]

Overall knowledge of first aid among students in this study was poor in comparison to student's awareness level in other studies. Hence, if a formal first aid session is introduced into medical curriculum then this will provide students with sound knowledge and practical skills as proven by an United Arab Emirates based study.[13] This should be complimented with hands on experience or activities in order to increase students' experiences in practical procedures during medical school followed by its evaluation as there is a problem of assessment of practical competence.[14]

The willingness of students to be trained in first aid skills and their agreement in favor of introduction of such training from school level onwards was similar to findings of Karachi study where in 94.4% medical students wanted first aid training to be part of their curriculum with 84% suggesting that it should be part of pre-university curriculum.[2] Another advantage of training students in first aid would be that they can be successful peer first aid trainers for others as opined by 97.7% medical students in Altintaş *et al.* study[15] and also reported in a Turkish study.[16] These measures will ensure that an increased number of first aid trainers are available at a time of any calamity faced by the people.

Use of modern techniques like using simulation with the aid of computerized mannequins as an educational and assessment

tools has been done before and found to be very effective in few studies.[9,15] Students in a New Zealand study for example felt that the simulations were a reasonable measure of their abilities and 91% felt that such simulations should be included in their end-of-year assessment. As current medical undergraduate training does not ensure new graduates can intervene effectively in an emergency, these simulation based workshops should be incorporated into the undergraduate curriculum both for education and assessment of competence in emergency management.[9] The other alternative would be patient simulation, which provides a safe learning environment (where events can be scheduled, repeated and observed) offering the potential for greater efficiency and rigor over traditional methods. Simulation has in fact been described as an ethical imperative, but has not yet been widely incorporated into the medical undergraduate curriculum the way it should have been.[17,18]

Strengths

No similar studies regarding awareness of first aid measures among medical students have been done in India before. The study has revealed that awareness on first aid measures needs to be improved amongst students. This is possible by introducing formal first aid training in the medical curriculum.

Limitations

This study only assessed the knowledge of first aid skills among medical students, but not the practical skills. Assessment of practical skills would have further helped in understanding the difficulties faced by students in rendering first aid during emergencies. This could be an area for future research studies. Moreover, as the study was performed in one medical college, the findings in this study cannot be generalized to all colleges in different parts of India. The required sample size also could not be achieved due to non-responses by few participants.

Conclusion

The level of knowledge about first aid was not good among most of the students. This study thus identified the need for introducing formal first aid training classes for medical students so that the trained students are competitive enough to provide first aid independently and spontaneously in real life situations. The study also brings out the need for first aid training as a felt need among medical students as there is no formal first aid training in the medical curriculum at the first place. This should be backed up with periodic refresher training as level of knowledge in first aid skills did not differ significantly between students with previous training in first aid and those without. The study also identified key areas in which first aid knowledge was lacking. More such studies should be conducted to evaluate the knowledge and skills of first aid among doctors and medical students in India.

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