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A Study On Lipid Profile In Anaemia.

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ABSTRACT

Anemia is defined as a reduction below normal limits of total red cell mass. As it is not easily measurable, it is defined as a reduction below normal of hematocrit or reduction in Haemoglobin concentration in blood, Mainly, the cause is iron deficiency. Plasma cholesterol level is closely related to Hematocrit levels, throughout the study, anemias are associated with hypocholesterolemia regardless of the type, low hematocrit is the cause of low cholesterol levels. This association appears due to changes in cholesterol distribution or plasma dilution because of the rapidity with which the cholesterol change occurred after transfusion. It is important to determine the extent of the relationship between cholesterol and Haemoglobin levels because cholesterol level is a risk factor for atherosclerosis and CHD studies revealed the significance of hypercholesterolemia related to anemia. To study the Lipid profile of anemic patients as compared with age & sex-matched controls.To correlate if the type of anemia has any effect on lipid profile.To study if the severity of anemia is associated with changes in various lipid subfractions. This is a study that has been carried out in the Department Of General Medicine, Government Mohan Kumaramangalam Medical College, Salem, Tamil Nadu, India in the year 2022. 100 patient were included in the study. 50 known cases of anemia & 50 age-matched controls.A detailed history was obtained from the subjects of the study, with special emphasis on age, sex, and occupation; non-specific symptoms of anemia like fatiguability, dyspnoea, giddiness, palpitations, and angina; symptoms suggestive of a specific cause for anemia like pica, dysphagia, abdominal pain, bony pain, fever, loss of appetite, weight loss, jaundice, bleeding, melaena, hemoglobinuria, menorrhagia, pregnancy, and post-menopausal bleeding. A history of disorders associated with dyslipidemia or anemia was obtained, including diabetes mellitus, hypertension, ischemic heart disease, cerebrovascular accident, AIDS, recent blood loss, and gallstones. Dietary habits and habits like alcoholism and tobacco smoking were ascertained. A history of intake of drugs affecting lipid levels, such as oral contraceptives, beta-blockers, diuretics, steroids, and NSAIDs was obtained. A family history of anemia, jaundice, and gallstones was also obtained. The cases and controls were matched for age. The majority of the cases were middle-aged (30-60). The youngest case was 14 years old. The oldest was 75 years old. Samples are sex-matched (P>0.05) sex is not statistically associated with hemoglobin levels (P>0.05)A total of 50 cases were included in this study. 20 cases had dimorphic anemia according to peripheral smear, 1 2 cases had microcytic hypochromic anemia (MH), 9 cases had normocytic hypochromic anemia (NH) and 5 cases had a normocytic normochromic blood picture (NN). Out of the 4 cases grouped as 'others' for analysis, 3 cases had megaloblastic anemia, 2 cases had pancytopenia, and one case each had chronic myeloid leukemia and leukoerythroblastic blood picture. A total of 9 cases had hemoglobin less than 6 gm/dl, 19 cases had hemoglobin between 6 and 9 gm/dl, and 22 cases had hemoglobin more than 9 gm/dl. Increased mean pulse rate (p=0.082) as well as significantly decreased mean BMI (P<0.01) m is seen in cases with HB < 6 gm/ml. Mean systolic and diastolic blood pressure is not significantly different. (p>0.05) The mean pulse rate was significantly higher in the other group (P<0.05). Mean systolic and diastolic blood pressures are not significantly different (P>0.05) Mean BMI is not significantly different (P>0.05) The mean serum total cholesterol levels were significantly lower (P<0.01) in cases (130.2 mg/dl) as compared to controls (172.4 mg/dl). The effect of anemia on total cholesterol levels was very large.The mean serum HDL levels were significantly lower (P<0.01) in cases (30.0 mg/dl) as compared to controls (38.9 mg/dl). The effect of anemia on HDL levels was large.The mean serum LDL levels were significantly lower (P<0.01) in cases (78.7 mg/dl) as compared to controls (111.1 mg/dl). The effect of anemia on the LDL levels was very large.The mean serum VLDL levels were significantly lower (P<0.01) in cases (20.6 mg/dl) as compared to controls (24.0 mg/dl). The effect of anemia on the VLDL levels was mild.The mean serum triglyceride levels were significantly lower (P<0.01) in cases (109.1 mg/dl) as compared to controls (123.5 mg/dl). The effect of anemia on triglyceride levels was mild.The mean total cholesterol / HDL ratio was significantly lower (P<0.05) in cases (4.34) as compared to controls (4.43). The effect of anemia on the TC/HDL ratio was mild.The mean LDL / HDL ratio was significantly lower (P<0.01) in cases (2.6) as compared to controls (2.85). The effect of anemia on the LDL/HDL ratio was mild. This study reveals that anemia is associated with hypercholesterolemia with a lowering in all lipid subfractions and the decrease is more strongly associated with total cholesterol and HDL levels compared to other subfractions. The extent of hypercholesterolemia is proportional to the severity of anemia.The type of anemia does not affect hypercholesterolemia.

Keywords: Elderly, Anemia, Hemoglobin, Iron Deficiency Anemia, Lipid Profile, Cholesterol, Triglyceride

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INTRODUCTION

Anemia is a common disorder in India. Although it may be due to various causes, iron deficiency is most commonly responsible. Anemia has been reported to have a beneficial effect on the lipid profile. The lowering of lipid levels is not related to the type of anemia. The decrease in serum cholesterol is not due to a specific lowering of any of the serum lipoprotein families; hypocholesterolemia is caused by a proportional reduction in all the major lipoprotein families. This may have a beneficial effect on the risk of developing coronary artery disease, a disease to which Indians are particularly susceptible. The exact mechanism by which anemia causes a fall in serum lipids is not known. [1] The simplest explanation is a dilution effect (the increased volume of serum in anemia carrying the same total load of cholesterol). Other possibilities are increased utilization of cholesterol by proliferating cells, decreased endogenous synthesis of cholesterol by the liver due to decreased liver oxygenation, elevated levels of the granulocyte-macrophage colony-stimulating factor, and enhanced receptor-mediated removal of LDL in the bone marrow. [2] Correction of anemia is associated with a rise in serum lipids. In this study, we documented and evaluated the demographic, lipid profile, and clinical features of anemia patients. [3] Current data indicate that serum lipid levels are significantly correlated with the risk of atherosclerosis, which causes coronary artery disease, cerebrovascular disease, and peripheral vascular disease, important causes of mortality and morbidity worldwide [4]. The burden of coronary artery disease (CAD) in India is increasing and addressing the risk factors of the same is the need of the hour to reduce its prevalence. Dyslipidemia is one of the important risk factors for CAD, effective preventive measures, including lifestyle modification should be adopted to achieve recommended lipid goals. Another equally important public health concern is the prevalence of anemia .[5] Dyslipidemia may be more prevalent in an affluent society, whereas anemia is more common in people with low socioeconomic status. Anemia could be associated with low levels of all the subfractions of lipoproteins Research studies have generated considerable novel information about the effect of serum lipids on heart disease and vascular disease. Elevated serum lipids have a significant correlation with the risk of atherosclerosis which in turn causes coronary artery disease, cerebrovascular disease & peripheral vascular disease, thus increasing morbidity & mortality worldwide. [6] The most common nutritional disorder encountered in India is Iron deficiency anemia, although there are plenty of reasons attributable to anemia. Studies are reporting the beneficial effect of anemia on lipid profiles. Typeof anemia does not influence the lowering of lipid levels. Decreased serum cholesterol levels are not due to specific lowering of any particular lipoprotein family, instead, it is observed that there occurs a proportionate decrease in all major lipoprotein families. [7]

METHODS

This is a study that has been carried out in the Department Of General Medicine, Government Mohan Kumaramangalam Medical College, Salem, Tamil Nadu, India in the year 2022. 100 patient were included in the study. 50 known cases of anemia & 50 age-matched controls. A detailed history was obtained from the subjects of the study, with special emphasis on age, sex, and occupation; non-specific symptoms of anemia like fatiguability, dyspnoea, giddiness, palpitations, and angina; symptoms suggestive of a specific cause for anemia like pica, dysphagia, abdominal pain, bony pain, fever, loss of appetite, weight loss, jaundice, bleeding, melaena, hemoglobinuria, menorrhagia, pregnancy, and post-menopausal bleeding. A history of disorders associated with dyslipidemia or anemia was obtained, including diabetes mellitus, hypertension, ischemic heart disease, cerebrovascular accident, AIDS, recent blood loss, and gallstones. Dietary habits and habits like alcoholism and tobacco smoking were ascertained. A history of intake of drugs affecting lipid levels, such as oral contraceptives, beta-blockers, diuretics, steroids, and NSAIDs was obtained. A family history of anemia, jaundice, and gallstones was also obtained. Inclusion Criteria: All proven cases of anemia. Men: Hb < 13 gm%, Women: Hb < 12 gm%.Exclusion Criteria:1.Children below 14 years 2.Obesity/Overweight: BMI > 25 kg/m^2, Alcoholics, Known case of Ischaemic Heart Disease/ Cerebrovascular Accident., History of recent blood loss.History of use of steroids, oral contraceptives, diuretics, and beta-blockers.Urine Albumin ≥ +,Blood Urea > 40 mg% or Serum Creatinine > 1.4 mg%,SGOT > 40 U/L or SGPT > 40 U/L or Serum Alkaline Phosphatase > 250 U/L,TSH > 7.0 µU/ml or TSH < 0.3 µU/ml.Venous blood was drawn for investigations like complete haemograms, random blood sugar, blood urea, serum creatinine, liver function tests, and thyroid stimulating hormone levels. A urine sample was obtained for urine analysis, including albumin, sugar, and microscopy. A fasting venous blood sample (> 12 hours) was obtained for the estimation of the lipid profile. T_3 and T_4 levels, fasting and post-prandial (two hours after an oral dose of 75 gms of glucose) blood sugar levels, and bone marrow aspiration cytology was done in selected cases based on clinical assessment. Complete haemogram was performed using the Sysmex automated analyzer. Hemoglobin

levels were confirmed by the colorimetric method. Differential count and peripheral smear were done manually using Leishmann's stain by a qualified pathologist. Urine albumin and sugar were estimated by the dipstick method. Urine microscopy was done manually by a qualified pathologist. Biochemical analyses were done using the fully automated Technicon RA-XT system by Bayer. TSH, T_4, and T_3 were estimated using the chemiluminescence method on the fully automated ADVIA Centaur system by Bayer. Estimation of total cholesterol, HDL, and triglycerides was done with the commercially available Autopak cholesterol kit on the Technicon RA-XT system. VLDL was calculated using the formula, VLDL = Triglyceride/5. LDL cholesterol was calculated using Friedewald's equation. LDL = Total cholesterol – [(Triglycerides/5) + HDL] mg/dl.

Statistical analysis

The statistical software used for the analysis of the data was SPSS 11.0 and Systat8.0. Microsoft Word and Excel have been used to generate figures and tables. Student t- test has been used to test the homogeneity of age between case and control. The Chi-square test has been used to find the homogeneity of sex between the case and control. Student t- test has been used to find the significance of Lipid profiles between cases and controls. Analysis of Variance has been usedto find the significance of mean lipid profiles when there are more than 2 groups. Mann Whitney U test has been carried out to find the significance between the case and control for TC/HDL and LDL/HDL ratio. Kruskal Wallis test has been used to find the significance of TC/HDL and LDL/HDL ratios when there are more than 2 groups.

RESULTS

A case-control study consisting of 50 anemic cases and 50 normal subjects was undertaken to study the clinical presentation of anemic cases and also to investigate the relationship between anemia and lipid profile. The cases and controls were matched for age. The majority of the cases were middle-aged (30-60). The youngest case was 14 years old. The oldest was 75 years old.

Table 1: Age Distribution With Haemoglobin Levels In Cases And Controls

Age inYears	Case Hemoglobin levels (in gm/dl) n=80				Control(n=50)
	< 6 (n=9)	6-9 (n=19)	> 9 (n=22)	Total (n= 50)	
20	1 (11.17)	1 (5.3)	2 (9.1)	4	4
21-30	2 (22.2)	5 (26.3)	3 (13.4)	10	10
31-40	2 (22.2)	5 (26.3)	4 (18.2)	11	11
41-50	1 (11.1)	3 (15.7)	2 (9.1)	6	6
51-60	1 (11.1)	2 (10.5)	7 (31.8)	10	10
61-70	1 (11.1)	2 (10.5)	3 (13.6)	6	6
>70	1 (11.1)	1 (2.3)	1 (4.5)	3	3

Samples are age-matched ($p>0.05$) Anaemic cases <50 years of are 2.42 times more to have Hb levels < 6 gm/dl ($p=0.107$) and Anamic cases >50 years of age are 4.31 times more likely to have > 9Hb gm/dl ($p<0.01$)

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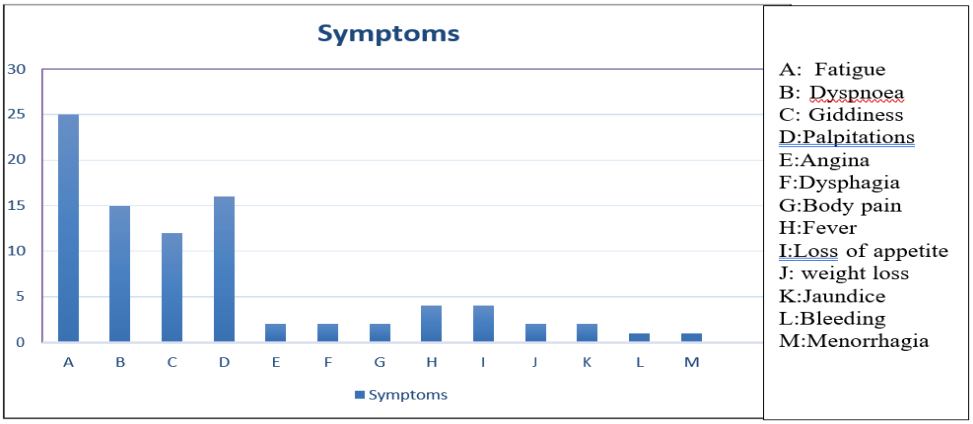
Table 2: Distribution Of Cases According To Type And Severity Of Anaemia

Hb (in gm/dl)	Type of Anaemia					
	DM	MH	NH	IN	Others	Total
<6	7	3	-	-	2	12
6-9	10	7	1	-	2	20
>9	3	2	8	5	0	18
Total	20	12	9	5	4	50

A total of 50 cases were included in this study. 20 cases had dimorphic anemia (DM) according to peripheral smear, 1 2 cases had microcytic hypochromic anemia (MH), 9 cases had normocytic hypochromic anemia (NH) and 5 cases had a normocytic normochromic blood picture (NN). Out of the 4 cases grouped as 'others' for analysis, 3 cases had megaloblastic anemia, 2 cases had pancytopenia, and one case each had chronic myeloid leukemia and leukoerythroblastic blood picture. A total of 9 cases had hemoglobin less than 6 gm/dl, 19 cases had hemoglobin between 6 and 9 gm/dl, and 22 cases had hemoglobin more than 9 gm/dl.

Graph 1: Symptoms



The most common presenting symptom was easy fatiguability, which was present in 25 cases. The next common symptoms were dyspnoea (15 cases), palpitations (16 cases), and giddiness (12 cases). Other symptoms were loss of appetite (4 cases), fever (2 cases), weight loss (2 cases), angina(2 cases), dysphagia, jaundice and menorrhagia (3 cases each), bony pain and bleeding (1 case) each. Not seen in the study group were pica, abdominal pain, melaena, hemoglobinuria, and pregnancy.

Table 3: Symptoms and severity of Anaemia

Presentingillness	Hemoglobin levels in cases (in gm/dl)			
	Total (n=50)	<6 (n=9)	6-9 (n=19)	>9 (n=22)
Fatigue	25	8 (88.9)	73.7 (14)	3 (13.6)
Dyspnoea	15	7 (77.8)	31.2	2 (9.09)
Giddiness	12	6 (66.7)	5 (26.3)	1 (4.5)
Palpitation	16	8 (88.9)	5 (26.3)	3 (13.6)
Angina	2	2 (22.2)	-	-
Pica	-	-	-	-
Dysphagia	2	2 (22.2)	-	-

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Abd pain	1	1 (11.1)	-	-
Bony pain	2	-	-	2 (9.0)
Fever	4	1 (11.1)	1 (5.3)	2 (9.0)
Loss of appetite	4	2 (22.2)	1 (5.3)	1 (4.5)
Wt loss	3	2 (22.2)	1 (5.3)	-
Jaundice	2	1 (11.1)	1 (5.3)	-
Bleeding	1	1 (11.1)	-	1 (2.7)
Malena	-	-	-	-
Haemoglobinuria	-	-	-	-
Menorrhagia	2	2 (22.2)	1 (5.3)	-
Pregnancy	-	-	-	-
Post-menopausal bleed	1	1 (11.1)	-	-

Cases with more severe anemia were found to be more likely to have symptoms. All cases with hemoglobin less than 6 gm/dl had at least one symptom, while out of 22 cases with hemoglobin more than 9 gm/dl, only 8 cases (36.4%) had at least one symptom. Most symptoms were found more frequently in cases with more severe anemia. 88.9 % of cases with hemoglobin less than 6 gm/dl complained of fatigue, compared to just 13.6 % of cases with hemoglobin more than 9 gm/dl. Fever, bony pain, and bleeding were the only symptoms that were found more frequently in cases with less severe anemia. Cases with severe anemia also had more symptoms. Cases with hemoglobin less than 6 gm/dl had an average of 3.7 symptoms, compared to cases with hemoglobin more than 9 gm/dl, which had only an average of 0.6 symptoms.

Table 4: General Physical Examination And Severity Of Anemia

GPU	Hemoglobin levels in cases (in gm/dl)			
	Total (n=50)	<6 (n=9)	6-9 (n=19)	>9 (n=23)
Pallor	30	9 (100.0)	17 (89.5)	4 (18.2)
Kollonyehia	10	8 (88.9)	2 (10.5)	-
Leterus	2	1 (11.1)	1 (5.3)	-
Pedal oedema	4	3 (38.3)	1 (5.3)	-
Lymphadenopathy	1	-	1 (5.3)	-
Glossitis	10	6 (66.7)	4 (21.1)	-
Angular stomatitis	5	4 (44.4)	1 (5.3)	-
Peterchiae	0	0	0	-
Haemolytis facies	0	0	0	-
Ankle ulcers	0	0	0	-
Peri oral Pigmentation	1	1 (11.1)	0	-
Knuckle Pigmentation	3	2 (22.2)	1	-

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The most common finding on general physical examination was pallor, which was present in 30 cases. Also seen were glossitis (10 cases), koilonychia (7 cases), angular stomatitis (5 cases), knuckle pigmentation (3 cases), pedal edema (4 cases), icterus (1 case), lymphadenopathy (1 case) and perioral pigmentation (1 case). None of the cases had petechiae, hemolytic facies, or ankle ulcers.

Cases with more severe anemia were found to be more likely to have findings on general physical examination. All cases with hemoglobin lessthan 6 gm/dl had at least one sign, while out of 2 2 cases with hemoglobin more than 9 gm/dl, only 6 cases (21.6%) had at least one sign. All signs were found more frequently in cases with more severe anemia. 100 % of cases with hemoglobin less than 6 gm/dl had pallor and 66.7% had glossitis, compared to just 21.1 % and 0% in cases with hemoglobin more than 9 gm/dl. Cases with severe anemia also had more signs on general physical examination. Cases with hemoglobin less than 6 gm/dl had an average of 2.8 signs, compared to cases with hemoglobin more than 9 gm/dl, which had only an average of 0.2 signs.

TABLE 5: Pulse Rate, Blood Pressure, And BMI With The Severity Of Anaemia

	Case Hemoglobin levels (in gm/dl)				Control(n=50)
	< 6 (n=9)	6-9 (n=19)	>9 (n=22)	Total (n=50)	
Mean pulse rate	89.3 ⍰ 12.8	83.6 ⍰ 9.8	84.9 ⍰ 7.5	85.4 ⍰ 10.0	83.7⍰ 16.9
Mean systolic blood pressure	118.7 ⍰ 9.7	121.3 ⍰8.5	122.7 ⍰ 10.4	121.2 ⍰ 9.6	122.1 ⍰ 15.2
Mean diastolic blood pressure	75.2 ⍰ 7.9	76.1 ⍰ 7.7	77.3 ⍰ 9.0	76.3 ⍰ 8.2	76.5 ⍰ 8.4
Mean BMI	20.9 ⍰ 1.5	22.0 ⍰ 1.7	21.4 ⍰ 1.6	21.5 ⍰ 1.7	21.6 ⍰ 1.6

Increased mean pulse rate (p=0.082) as well as significantly decreased mean BMI (P<0.01) m is seen in cases with HB < 6 gm/ml. Mean systolic and diastolic blood pressure is not significantly different. (p>0.05)

Graph:2 Systemic examination

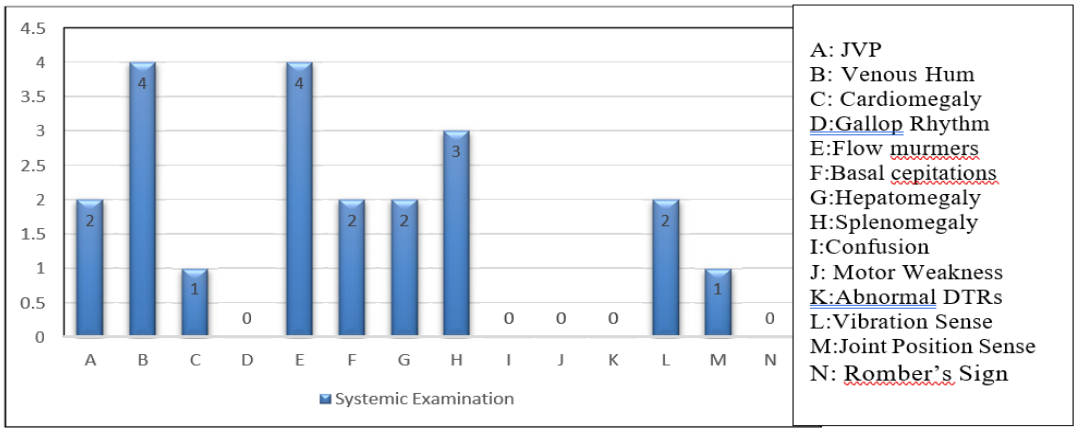

Table 6: Pulse Rate, Blood Pressure, And BMI With The Type Of Anaemia

	Types of Anaemia				
	DM (n=40)	MH (n=25)	NH (n=18)	NN (n=10)	Others(n=7)
Mean pulse rate	85.0 ⍰ 8.5	82.3 ⍰12.0	87.0 ⍰ 7.5	84.1 ⍰ 5.2	96.3 ⍰ 14.9
Mean systolic	120.1 ⍰ 9.8	122.3 ⍰ 8.9	118.9 ⍰ 8.3	126 ⍰ 11.7	122.9 ⍰ 9.5
Mean diastolicblood pressure	75.1 ⍰ 6.7	75.6 ⍰ 10.0	77.2 ⍰ 8.3	79.0 ⍰ 8.8	80.0 ⍰ 8.2
Mean BMI	21.5 ⍰ 1.7	21.4 ⍰ 1.7	21.6 ⍰ 1.8	21.4 ⍰ 1.4	21.8 ⍰ 1.9

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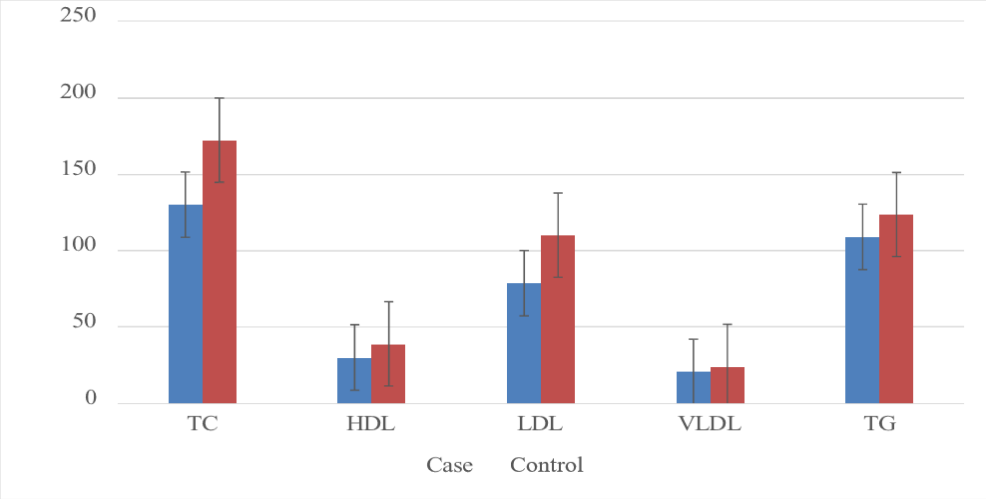
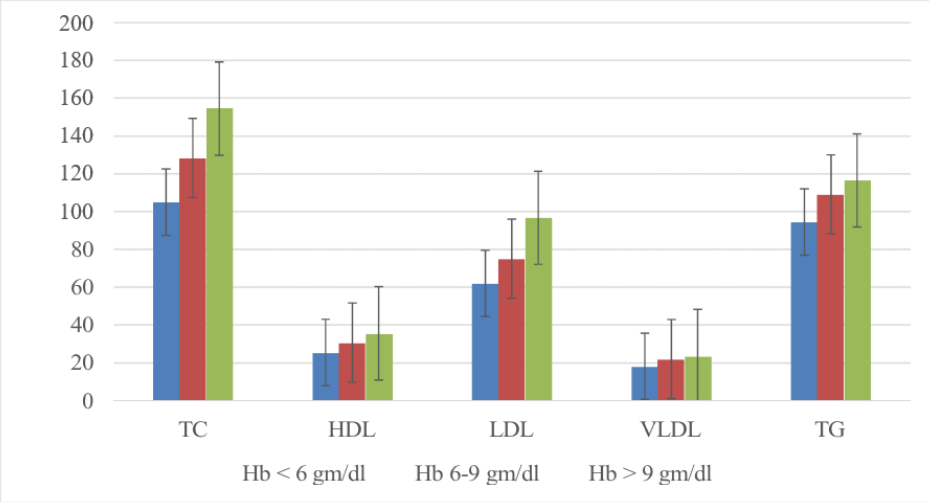
The mean pulse rate was significantly higher in the other group (P<0.05). Mean systolic and diastolic blood pressures are not significantly different (P>0.05) Mean BMI is not significantly different (P>0.05).

The most common findings on systemic examination were venous hum and flow murmurs (4 cases each). Abdominal examination revealed 3 cases of splenomegaly and 2 cases of hepatomegaly. CNS findings were impairment of vibration sense (2 cases) and joint position sense (1 case), suggestive of peripheral neuropathy. Elevated JVP, cardiomegaly, and basal crepitations were seen in 2 cases each. Cardiovascular and respiratory findings such as elevated JVP, venous hum, cardiomegaly, flow murmurs, and basal crepitations were found only in cases with hemoglobin less than 6 gm/ dl, except for one case with hemoglobin between 6 and 9 gm/ dl, who had a flow murmur. Impairment of vibration and joint position sense were also found only in cases with severe anemia. Hepatomegaly and splenomegaly were found in allgroups of cases equally.

Graph 4: Anaemia and Lipid Profile



Graph 5: Severity Of Anaemia And Lipid Profile



The mean serum total cholesterol levels were significantly lower (P<0.01) in cases (130.2 mg/dl) as compared to controls (172.4 mg/dl). The effect of anemia on total cholesterol levels was very large. The mean serum HDL levels were significantly lower (P<0.01) in cases (30.0 mg/dl) as compared to controls (38.9 mg/dl). The effect of anemia on HDL levels was large. The mean serum LDL levels were significantly lower (P<0.01) in cases (78.7 mg/dl) as compared to controls (111.1 mg/dl). The effect of anemia on the LDL levels was very large. The mean serum VLDL levels were

significantly lower (P<0.01) in cases (20.6 mg/dl) as compared to controls (24.0 mg/dl). The effect of anemia on the VLDL levels was mild. The mean serum triglyceride levels were significantly lower (P<0.01) in cases (109.1 mg/dl) as compared to controls (123.5 mg/dl). The effect of anemia on triglyceride levels was mild. The mean total cholesterol / HDL ratio was significantly lower (P<0.05) in cases (4.34) as compared to controls (4.43). The effect of anemia on the TC/HDL ratiowas mild. The mean LDL / HDL ratio was significantly lower (P<0.01) in cases(2.6) as compared to controls (2.85). The effect of anemia on the LDL/HDL ratio was mild.

The mean serum total cholesterol levels were significantly lower (P<0.01) in cases with hemoglobin less than 6 gm/dl (105.0 mg/dl), as compared to cases with hemoglobin more than 9 gm/dl (154.7 mg/dl). The mean serum HDL levels were significantly lower (P<0.01) in cases with hemoglobin less than 6 gm/dl (25.3 mg/dl), as compared to cases withhemoglobin more than 9 gm/dl (35.5 mg/dl). The mean serum LDL levels were significantly lower (P<0.01) in cases with hemoglobin less than 6gm/dl (62.0 mg/dl), as compared to cases with hemoglobin more than 9 gm/dl (96.8 mg/dl). The mean serum VLDL levels were significantly lower (P<0.01) in caseswith hemoglobin less than 6 gm/dl (18.0 mg/dl), as compared to cases with hemoglobin more than 9 gm/dl (23.4 mg/dl). The mean serum triglyceride levels were significantly lower (P<0.01) in cases with hemoglobin less than 6 gm/dl (94.4 mg/dl), as compared to cases with hemoglobin more than 9 gm/dl (116.6 mg/dl). The mean serum total cholesterol/HDL ratio was significantly lower (P<0.05) in cases with Hb less than 6 gm/dl (4.15), as compared to cases with Hb more than9 gm/dl (4.35). The mean serum LDL/HDL ratio was significantly lower (P<0.01) in cases with Hb less than 6 gm/dl (2.45), as compared to cases with Hb more than 9 gm/dl(2.72).

Table 7 Type of Anaemia and Lipid Profile

Lipid Profile (mean ⍰ SD)	Hb (in gm/dl)	Type of Anaemia					P Value (ANOVA)
		DM	MH	NH	NN	OTHERS	
TC In Mg/dl	<6	108.4 ⍰ 19.3	106.6⍰ 23.6	-	-	93.3 ⍰ 25.9	P > 0.05
	6-9	125.8 ⍰ 20.9	132.6 ⍰ 26.2	113.0 ⍰ 18.3	-	118.5 ⍰ 2.1	P > 0.05
	>9	158.6 ⍰ 22.5	143.6 ⍰ 31.2	151.8 ⍰ 23.6	163.6 ⍰ 13.0	107.0⍰ 0	P > 0.05
HDL (in mg/dl)	<6	21.6 ⍰ 6.6	25.6 ⍰ 3.6	-	-	248⍰ 7.4	P > 0.05
	6.9	30.3 ⍰ 6.1	28.2 ⍰ 7.2	31.0 ⍰ 0	-	30.0 ⍰9.9	P > 0.05
	>9	36.4 ⍰ 4.2	32.8 ⍰ 4.0	32.4 ⍰ 4.9	36.4 ⍰ 4.1	24. 0 ⍰ 0^8	P > 0.05
LDL (in mg/dl)	>6	65.7 ⍰ 16.0	64.4 ⍰ 22.5	-	-	44.5 ⍰22.4	P > 0.05
	6-9	74.3 ⍰ 17.7	78.4 ⍰27.2	58.0 ⍰14.1	-	75.5 ⍰12.0	P > 0.05
	>9	79.3 ⍰ 18.7	40.6 ⍰ 32.3	93.0 ⍰23.0	104.4⍰ 12.4	60.0 ⍰ 0^8	P > 0.05
VLDL (in mg/dl)	<6	18.6 ⍰ 7.3	17.6 ⍰ 5.3	-	-	25.0 ⍰ 8.4	P > 0.05
	6-9	21.2 ⍰ 5.5	23.1 ⍰ 5.8	25.0 ⍰ 4.2	-	21.0 ⍰0	P > 0.05
	>9	24.0 ⍰ 5.0	20.2 ⍰ 4.4	25.4 ⍰6.7	21.8 ⍰5.2	23.0 ⍰ 0^8	P > 0.05
TG(in mg/dl)	<6	81.6 ⍰ 36.3	89.0 ⍰ 27.3	-	-	124.8 ⍰41.1`	P > 0.05
	6-9	102.5 ⍰ 27.8	115.7 ⍰ 29.3	125.0 ⍰ 21.2	-	103.5 ⍰ 0.7	P > 0.05
	>9	113.2 ⍰ 26.4	101.4 ⍰ 23.4	126.6 ⍰32.4	109.5 ⍰25.7	114.0 ⍰ o^8	P > 0.05
TC /HDL	<6	5.0 ⍰ 0.007	2.2⍰ 1.0	-	-	3.8 ⍰ 0.4	P > 0.05^K
	6-9	4.1 ⍰0.08	4.3 ⍰ 0.9	-	-	4.0 1.5	P > 0.05^K
	>9	4.4 ⍰ 0.7	4.4 ⍰ 1.1	3.8 ⍰0.06	4.5 ⍰ 0.5	4.5 0^8	P > 0.05^K

LDLHDL	<6	3.0 ⍰ 0.6	2.8 ⍰ 1.0	4.7 ⍰ 0.8	-	1.8 ⍰0.6	P > 0.05[K]
	6-9	2.5 ⍰ 0.06	4.7 ⍰ 0.7	0.5	-	2.6 ⍰ 1.2	P > 0.05[K]
	>9	2.1 ⍰ 0.6	1.23 ⍰ 1.1	2.9 ⍰ 0.7	2.9 ⍰ 0.5	2.5 ⍰ 0[#]	P > 0.05[K]

Since the severity of anemia was found to have a significant effect on the lipid profile, analysis of the effect of type of anemia on lipid profile was done by further subdividing the types of anemia based on severity and comparing the lipid profile in groups having varying types of anemia with similar severity. There was no significant difference (P>0.05) in the mean total cholesterol levels in different types of anemia with similar levels of hemoglobin. There was no significant difference (P>0.05) in the mean HDL levels in different types of anemia with similar levels of hemoglobin. There was no significant difference (P>0.05) in the mean LDL levels in different types of anemia with similar levels of hemoglobin. There was no significant difference (P>0.05) in the mean VLDL levels in different types of anemia with similar levels of hemoglobin. There was no significant difference (P>0.05) in the mean triglyceride levelsin different types of anemia with similar levels of hemoglobin. There was no significant difference in the mean total cholesterol / HDL ratio (P>0.05) and mean LDL / HDL ratio (P>0.05) in different types of anemia with similar levels of hemoglobin.

Table 14: Type of Anaemia and lipid profile

Lipid Profile (mean ⍰ SD)	Hb (in gm/dl)	Type of Anaemia					P Value (ANOVA)
		DM	MH	NH	NN	OTHERS	
TC In Mg/dl	<6	108.4 ⍰ 19.3	106.6⍰ 23.6	-	-	93.3 ⍰ 25.9	P > 0.05
	6-9	125.8 ⍰ 20.9	132.6 ⍰ 26.2	113.0 ⍰ 18.3	-	118.5 ⍰ 2.1	P > 0.05
	>9	158.6 ⍰ 22.5	143.6 ⍰ 31.2	151.8 ⍰ 23.6	163.6 ⍰ 13.0	107.0⍰ 0	P > 0.05
HDL (in mg/dl)	<6	21.6 ⍰ 6.6	25.6 ⍰ 3.6	-	-	248⍰ 7.4	P > 0.05
	6.9	30.3 ⍰ 6.1	28.2 ⍰ 7.2	31.0 ⍰ 0	-	30.0 ⍰9.9	P > 0.05
	>9	36.4 ⍰ 4.2	32.8 ⍰ 4.0	32.4 ⍰ 4.9	36.4 ⍰ 4.1	24. 0 ⍰ 0[8]	P > 0.05
LDL (in mg/dl)	>6	65.7 ⍰ 16.0	64.4 ⍰ 22.5	-	-	44.5 ⍰22.4	P > 0.05
	6-9	74.3 ⍰ 17.7	78.4 ⍰27.2	58.0 ⍰14.1	-	75.5 ⍰12.0	P > 0.05
	>9	79.3 ⍰ 18.7	40.6 ⍰ 32.3	93.0 ⍰23.0	104.4⍰ 12.4	60.0 ⍰ 0[8]	P > 0.05
VLDL (in mg/dl)	<6	18.6 ⍰ 7.3	17.6 ⍰ 5.3	-	-	25.0 ⍰ 8.4	P > 0.05
	6-9	21.2 ⍰ 5.5	23.1 ⍰ 5.8	25.0 ⍰ 4.2	-	21.0 ⍰0	P > 0.05
	>9	24.0 ⍰ 5.0	20.2 ⍰ 4.4	25.4 ⍰6.7	21.8 ⍰5.2	23.0 ⍰ 0[8]	P > 0.05
TG(in mg/dl)	<6	81.6 ⍰ 36.3	89.0 ⍰ 27.3	-	-	124.8 ⍰41.1`	P > 0.05
	6-9	102.5 ⍰ 27.8	115.7 ⍰ 29.3	125.0 ⍰ 21.2	-	103.5 ⍰ 0.7	P > 0.05
	>9	113.2 ⍰ 26.4	101.4 ⍰ 23.4	126.6 ⍰32.4	109.5 ⍰25.7	114.0 ⍰ o[8]	P > 0.05
TC /HDL	<6	5.0 ⍰ 0.007	2.2⍰ 1.0	-	-	3.8 ⍰ 0.4	P > 0.05[K]
	6-9	4.1 ⍰0.08	4.3 ⍰ 0.9	-	-	4.0 1.5	P > 0.05[K]
	>9	4.4 ⍰ 0.7	4.4 ⍰ 1.1	3.8 ⍰0.06	4.5 ⍰ 0.5	4.5 0[8]	P > 0.05[K]
LDLHDL	<6	3.0 ⍰ 0.6	2.8 ⍰ 1.0	4.7 ⍰ 0.8	-	1.8 ⍰0.6	P > 0.05[K]
	6-9	2.5 ⍰ 0.06	4.7 ⍰ 0.7	0.5	-	2.6 ⍰ 1.2	P > 0.05[K]
	>9	2.1 ⍰ 0.6	1.23 ⍰ 1.1	2.9 ⍰ 0.7	2.9 ⍰ 0.5	2.5 ⍰ 0[#]	P > 0.05[K]

There is no statistically significant difference in lipid fractions between different types of anemia (P>0.05)# - p value could not be computed as there was only one case. K –Kruskal Wallies Test

DISCUSSION

All cases in this study were between 14 and 75 years. The majority of the cases were middle-aged (30-60 years). Anemic cases younger than 50 years were more likely to have more severe anemia, as compared to cases older than 50 years, who were more likely to have less severe anemia. This is probably due to younger individuals having a higher risk of worm infestations, and also the onset of menopause with cessation of menstrual blood loss after the age of 50 years.The cases consisted of 22 males and 28 females. There was no correlation between sex and the severity of anemia.Dimorphic anemia was the most commonly seen type of anemia in this study. Microcytic hypochromic anemia was the second most common, followed by normocytic hypochromic anemia, and those with normocytic normochromic blood picture.[8] Only a few cases of megaloblastic anemia and pancytopenia, and one case of chronic myeloid leukemia were seen. This is consistent with standard textbooks of medicine, which describe nutritional deficiencies, especially iron deficiency, to be the most common cause of anemia. Most cases had mild to moderate anemia, as defined by a hemoglobin level above 6 gm/dl. None of the cases with normocytic hypochromic anemia or normocytic normochromic blood picture had severe anemia. Cases commonly presented with nonspecific symptoms of anemia, such as fatigue, dyspnoea, palpitations, and giddiness.[9] Symptoms suggestive of a specific cause for anemia were rarely seen.Cases with more severe anemia were more likely to have symptoms and had more symptoms. Patients with hemoglobin of more than 10 gm/dl were usually asymptomatic and incidentally detected to have anemia on routine evaluation. Nonspecific symptoms such as fatigue, dyspnoea, giddiness, palpitations, fever, loss of appetite, and loss of weight were equally frequent in the different types of anemia, except normocytic hypochromic anemia and cases with normocytic normochromic blood picture.This is possible because these cases had less severe anemia. [10] Pallor was the most common finding on general physical examination. Cases with more severe anemia were found to be more likely to have findings on general physical examination. Signs were usually not seen in cases with hemoglobin less than 10 gm/dl. Koilonychia, lymphadenopathy, glossitis, and angular stomatitis were seen only in cases with dimorphic anemia and microcytic hypochromic anemia. Knuckle pigmentation and perioral pigmentation were seen only in cases with megaloblastic anemia and dimorphic anemia. This is consistent with descriptions given in standard textbooks of medicine.The mean pulse rate was higher in anemic cases when compared to nonanemic controls. The mean pulse rate was higher in cases with more severe anemia. The pulse rate has been described to be higher in t h e case of anemia, in standard textbooks of medicine.[11] This is part of a compensatory mechanism to raise cardiac output and maintain tissue oxygenation. Murray RK, in 2000, demonstrated that anemia causes a rise in pulse rate and stroke volume in patients whose hemoglobin was lowered from 13 gm/dl to 8 gm/dl.The mean blood pressure was comparable in cases and controls. It was lower in cases with more severe anemia. This is due to peripheral vasodilatation, another compensatory mechanism to raise cardiac output and maintain tissue oxygenation. [12] Young SG, al, demonstrated that redistribution of blood volume and vasodilatation played a dominant role in the hyperkinetic circulatory response to chronic anemia.The most common findings on systemic examination were venous hum and flow murmurs. Features suggestive of a hyperdynamic state of the circulation and congestive cardiac failure were only seen in cases with severe anemia. Features suggestive of peripheral neuropathy were seen only in cases with megaloblastic anemia and dimorphic anemia. The results of this study confirm the findings of previous investigators that the mean serum total cholesterol, HDL, LDL, VLDL, and triglyceride levels are decreased in anemia.The mean total cholesterol was found to be lower in anemic cases when compared to controls. The decrease in mean serum cholesterol was not due to a specific lowering of any of the serum lipoprotein families; hypocholesterolemia was caused by a reduction in all the major lipoprotein families, including mean HDL, LDL, VLDL, and triglycerides. There was a very large decrease in mean total cholesterol and LDL levels, and a large decrease in mean HDL levels, resulting in a mild fall in mean TC/HDL and LDL/HDL ratios.[13] There was a mild decrease in mean VLDL and triglyceride levels showing that anemia was associated with hypocholesterolemia and the decrease in serum cholesterol was not due to a specific lowering of any of the serum lipoprotein families and that hypocholesterolemia was caused by a proportional reduction in all the major lipoprotein families.[14] Keys A conducted a study of 4,070 women and demonstrated a significant difference in cholesterol between women with hemoglobin levels above and below 10.5g/dL.Patients with more severe anemia were found to have a larger fall in mean total cholesterol and all the lipid sub-fractions. This suggests that the severity of anemia is responsible for the hypocholesterolemia seen in anemia.[15] A study conducted by

Gotto AM et al in 2001 showed that lipid levels in patients with iron deficiency anemia were directly related to hemoglobin levels.The type of anemia did not have a significant effect on the mean lipid levels. This suggests that it is anemia per se and not the type of anemia that is responsible for the lowering of lipid levels in anemia. [16] Fuster V et.al examined the relationship between hypocholesterolemia and various types of anemia, including megaloblastic anemia, hereditary spherocytosis, homozygous sickle cell disease, aplastic anemia, and liver-associated anemia. The study showed that the plasma cholesterol level is closely related to hematocrit levels, both initially and throughout the anemias associated with hypocholesterolemia. This association was maintained regardless of the cause of changes in hematocrit levels.[1718,19,20]

CONCLUSION

Younger individuals are more likely to have severe anemia. Cases with severe anemia have more symptoms. They have higher mean pulse rate, lower mean blood pressure, and mean BMI. Vegetarians are more likely to have severe anemia. Cases with severe anemia also have more signs on examination. Anemia is associated with significant hypocholesterolemia, with a lowering in all lipid subfractions. The extent of hypocholesterolemia is proportional to the severity of anemia. The mean total cholesterol, HDL, LDL, VLDL, and triglyceride levels, along with TC/HDL and LDL/HDL ratios were significantly decreased in cases compared to controls. There was a larger reduction in mean total cholesterol, HDL, LDL, VLDL, and triglyceride levels, along with TC/HDL and LDL/HDL ratios with increased severity of anemia. The type of anemia does not affect the hypocholesterolemia seen in anemia. Further studies are required to study the long term effect of anemia on the risk of developing atherosclerosis, and to study the long term effect of treatment of anemia on lipid levels and cardiovascular morbidity and mortality.

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