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ASSOCIATION BETWEEN SERUM TOTAL CHOLESTEROL LEVELS AND NOSOCOMIAL INFECTIONS AFTER GASTROINTESTINAL SURGERY

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ABSTRACT

Introduction: Infection occurring in a patient in a hospital or other healthcare facilities in whom the infection was not present or incubating at the time of admission is known as Nosocomial infection. This includes infections acquired in hospital but appearing after discharge and also occupational infections among staff of the facility. It is a very serious complication and associated with increased mortality, morbidity increased treatment cost. There is a relationship between Nosocomial infection and Serum total cholesterol level. Hypercholesterolemia is protective though it may cause several cardiovascular diseases. Circulating cholesterol-rich lipoproteins and triglyceride-rich lipoproteins have the capacity to bind and detoxify bacterial lipopolysaccharide (LPS). HDL has been shown to compete with LPS binding protein (LBP) for binding to LPS. **Methods:** This study was an observational study which was conducted at surgery department of Dhaka Medical College & Hospital, over a period of one year between November 2016 to November 2017. All admitted patients underwent gastrointestinal surgery were included in this study. A purposive sampling technique was applied to select the study sample. Main outcome variables were Superficial and deep SSI, Organ space SSI, Pneumonia, UTI. Serum albumin level, Total cholesterol level, Preoperative diagnosis, Site of operation, Operation time, Blood loss, Blood transfusion, Hospital stay, Age, Sex, Smoking were other independent variables. Data processing and analysis were done using SPSS (statistical package for social sciences), version 20. The test statistics used to analyze the data are cross sectional statistics. The summarized data were presented in the form of tables with due statistical interpretation. Statistical significance were determined by Chi-square Test (x^2). **Results:** Among 150 patients 130 (86.7%) were below 60 years of age and 20 (13.3%) were above 60 years of age. Mean age was 44 years and standard deviation was 13. Among the 150 patients 98 (65.3%) were male and 52 (34.7%) were female in this study the overall incidence of Nosocomial infection was found 36.7% (n =55). Among them most commonly found infection was Superficial & Deep SSI 20.7% (n = 31) and least incidence was found in case of Pneumonia, only 06 cases was found which was about 4%. In case of Organ space infection incidence was 5.3% (n=08) and Urinary tract infection was found 6.7% (n=10). Overall postoperative mortality occurred within 60 days of operation was 5.3% (n=8) which was statistically significant in case of Organ space infection (P <0.05). Lowest quartile (<159 mg / dl) of total serum cholesterol level (45.8%, n= 11, P <0.05), low serum albumin level (< 4 mg / dl) and operation time (121- 300 min) and preoperative diagnosis were found independent predictors of development of superficial and deep SSI. About 17 (29.3%) cases were found infected, those who have serum albumin level within (3.2- 3.5 mg /dl) and P value was <0.05. Smoking, Serum total cholesterol level, Preoperative diagnosis and operation time were found strong predictors for development of nosocomial infection. Among 76 smoker cases only eight patients were found infected (P = .006). About 16.7 % (n= 04) patients were found having total cholesterol level < 159 mg/dl (P = .049). Six patients were infected with pneumonia among this 04 were aged more than 60 years (P = .003). None of preoperative variables were associated with development with UTI except age of the patients. **Conclusion:** Low serum total cholesterol level, low serum albumin level, prolong operation time, Malignant cases and smoking are significantly associated with postoperative nosocomial infection. Nosocomial infections are associated with prolong hospital stay and mortality.

KEYWORDS: Hypercholesterolemia, nosocomial infection, Serum total cholesterol level.

INTRODUCTION

Cholesterol is a sterol; It is one of three major classes of lipids which all animal cells use to construct their membranes and is thus manufactured by all animal cells. It is also the precursor of the steroid hormones and bile acids. Since cholesterol is insoluble in water, it is transported in the blood plasma within protein particles (lipoproteins). Lipoproteins are classified by their density: very low density lipoprotein (VLDL), low density lipoprotein (LDL), intermediate density lipoprotein (IDL) and high density lipoprotein (HDL). All the lipoproteins carry cholesterol, but elevated levels of the lipoproteins other than HDL (termed non-HDL cholesterol), particularly LDL-cholesterol, are associated with an increased risk of atherosclerosis and coronary heart disease.[1] In contrast, higher levels of HDL cholesterol are protective.[2] Hypercholesterolemia (also called dyslipidemia) is the presence of high levels of cholesterol in the blood that has been associated with an increased incidence of coronary-heart-disease-related death and inversely related to deaths caused by some cancers, respiratory disease, digestive disease, and trauma.[3,4] Several studies show that there is an inverse relation between serum total cholesterol and postoperative nosocomial infections. Some non-mutually exclusive explanations for the inverse association between total cholesterol and nosocomial infections are possible. First, low total serum cholesterol may contribute to the development of infections. Circulating cholesterol-rich lipoproteins and triglyceride-rich lipoproteins have the capacity to bind and detoxify bacterial lipopolysaccharide (LPS).[5] HDL has been shown to compete with LPS binding protein (LBP) for binding to LPS. The LPS-LBP complex attaches to the CD-14 receptor on cells, which, in turn, stimulates TNF production.[6] In vitro and in vivo models of endotoxemia in rodents have shown that lipoproteins, such as LDLs, VLDLs, HDLs, lipoprotein, triglycerides, and chylomicrons, can modulate the bioactivity of LPS.[6–8] Second, cholesterol is the precursor of five major classes of steroid hormones. Cholesterol affects gluconeogenesis and immune function; its transport forms, the lipoproteins, also serve as vehicles for fat-soluble vitamins, antioxidants, drugs, and toxins. These hormones are synthesized from cholesterol mostly in the adrenal gland and gonads in response to tissue specific trophic hormones. These steroidogenic tissues are unique in that they require cholesterol not only for membrane biogenesis, maintenance of membrane fluidity, and cell signaling but also as the starting material for the biosynthesis of steroid hormones.[9] High cholesterol may be protective, possibly through a beneficial influence on the immune system. Low serum cholesterol is related to the development of organ dysfunction and mortality in critically ill surgical patients.[10] Some studies have demonstrated that very low density lipoprotein (VLDL) and chylomicrons, as well as high-density lipoprotein (HDL), (low-density lipoprotein (LDL) and cholesterol, can protect against endotoxin-induced sepsis.[11] I am doing this study to evaluate these parameters as predictors of the development of nosocomial infections in a group of patients undergoing various elective gastrointestinal surgical procedures.

OBJECTIVE

General

- To find out the association between serum total cholesterol levels and nosocomial infection after gastrointestinal surgery in surgery department of DMCH.

Specific

- To find out the relationship between serum total cholesterol level and superficial and deep SSI, organ space SSI, pneumonia and UTI after gastrointestinal surgery.
- To find out relation between postoperative nosocomial infection and length of hospital stay.
- To find out the relation between nosocomial infection and postoperative mortality.

METHODOLOGY

This study was an observational study which was conducted at surgery department of Dhaka Medical College & Hospital, over a period of one year between November 2016 to November 2017. All admitted patients underwent gastrointestinal surgery were included in this study. A purposive sampling technique was applied to select the study sample. Main outcome variables were Superficial and deep SSI, Organ space SSI, Pneumonia, UTI. Serum albumin level, Total cholesterol level, Preoperative diagnosis, Site of operation, Operation time, Blood loss, Blood transfusion, Hospital stay, Age, Sex, Smoking were other independent variables. Data processing and analysis were done using SPSS (statistical package for social sciences), version 20. The test statistics used to analyze the data are cross sectional statistics. The summarized data were presented in the form of tables with due statistical interpretation. Statistical significance were determined by Chi-square Test (X^2).

Inclusion Criteria: Patients undergoing elective gastrointestinal surgery, Age above 18 years.
Exclusion criteria: Critically ill patient, Patient undergoing emergency operation, Patient having OM, Patient on steroid therapy, Patient on chemotherapy, Patient in immunocompromised condition, Patients did not give consent.

RESULTS

Among 150 patients 130 (86.7%) were below 60 years of age and 20 (13.3%) were above 60 years of age. Mean age was 44.8 years and standard deviation was 12.9. (Table 1). Among the 150 patients 98 (65.3%) were male and 52 (34.7%) were female. (Table 2)

Table 1: Age distribution of patients.

Age (years)	Frequency	Percentage (%)	T	n	%
<60	130	86.7	55	41	74.54
>60	20	13.3	55	14	25.45
Total	150				

Mean age: 44.8 years
SD: 12.9 years
T: Total number of cases of nosocomial infection
n: number infected cases
%: Percentage

Table 2: Sex distribution of patients.

Sex	Frequency	Percentage (%)	T	n	%
Male	98	65.3	55	43	78.18
Female	52	34.7	55	12	21.81
Total	150				

T: Total number of cases of nosocomial infections
n: Infected cases
%: Percentage

Twelve patients were found infected having serum albumin level within range 3.6-4.0 mg/dl (P <0.05). 21 cases needed operation time 120- 300 min found infected (31.8%, P = 0.004). (Table 3)

Variables associated with development of Organ space infection were analyzed. Smoking, Serum total cholesterol level, Preoperative diagnosis and operation time were found strong predictors for development of infection. Among 76 smoker cases 10.3%, (n =08) were infected (P .006). About 16.7% (n= 04) patients having total cholesterol level < 159 mg/dl (P .049). All infected cases were preoperatively diagnosed as malignant (n= 08, 16%, P< 0.05). All infected cases needed operation time 120 min – 300 min (n = 08, 12.1%, P = .001). In case of Organ space infection Serum albumin level was found statistically insignificant. (Table 3)

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Table 3: Relationship of variables with superficial and deep SSI (n=31)

	Superficial & deep SSI			
	Total	n	%	P
Current smoker				
Yes	76	19	25	.228
No	74	12	16.2	.228
Statin use				
Non-statin use	130	27	20.8	1.00
Statin in use	20	04	20	1.00
Albumin level				
<3 gm/dl	02	02	100	.000
3.1-3.5 gm/dl	58	17	29.3	.000
3.6-4.0 gm/dl	58	12	20.7	.000
4.0-4.5 gm/dl	32	00	00	
>4.5 gm/dl	00	00	00	
Total cholesterol level				
<159	24	11	45.8	.000
160- 199	42	12	28.6	.000
200- 239	66	04	6.10	
>240	18	04	22.2	.000
Operation Time				
120 min	84	10	11.9	.004
121-300	66	21	31.8	.004
>300				

	00	00	00	
Preoperative diagnosis				
Benign	100	14	14	.004
Malignant	50	17	34	.004
n : Number of infected case				
% : Percentage				
P : P value				
SSI : Surgical site infection				

Table 4: Relation of different variables with Organ space SSI (n= 08)

	Organ space SSI			
	Total	**n**	**%**	**P**
Age				
<60	130	06	4.6	.289
>60	20	02	10	.289
Current smoker				
Yes	76	08	10.5	.006
No	74	00	00	
Albumin level				
<3 gm/dl	02	00	00	
3.1-3.5 gm/dl	58	06	10.3	.57
3.6-4.0 gm/dl	58	02	3.40	.57
4.0-4.5 gm/dl	32	00	00	
>4.5 gm/dl	00	00	00	
Total cholesterol level				
<159	24	04	16.7	.049
160- 199	42	02	4.8	.049
200- 239	66	02	3.0	
>240	18	00	00	
Preoperative diagnosis				
Benign	100	00	00	
Malignant	50	08	16	.000
Blood transfusion				
Yes	78	08	10.3	.007
No	72	00		
	n : number of infected case **% :** Percentage **P :** P value **SSI :** Surgical Site Infection			

None of preoperative variables were associated with development with UTI except age. Out of 10 infected cases 06 were found aged > 60 years (p .029) (Table 5)

Postoperative hospital stay period was significant for superficial and deep SSI, Organ space SSI, Pneumonia. For Superficial and deep SSI hospital stay < 15 days was 9.7% and >15 days was 90.3% ($p < 0.05$). Patients having Organ space infection and Pneumonia hospital stay period > 7 days was 100% ($P < 0.05$). In case of UTI it was found statistically insignificant. (Table 6)

Table 5: Association of variables with postoperative UTI (n= 10)

	UTI			
	total	**n**	**%**	**p**
Age				
<60	130	06	4.6	
>60	20	04	20	.029
Sex				
Male	98	08	8.2	.495
Female	52	02	3.8	.495
Total cholesterol level				
<160	24	04	16.7	.069

161- 200	42	04	9.5	
201- 240	66	02	3.0	.069
>240	18	00		
Operation Time				
120 min	84	05	6.0	.692
121-300	66	05	6.7	.692
>300	00	00		
Albumin level				
<3 gm/dl	02	00	00	
3.1-3.5 gm/dl	58	05	8.6	.869
3.6-4.0 gm/dl	58	03	5.2	
4.0-4.5 gm/dl	32	02	6.2	
>4.5 gm/dl	00	00	00	
Blood transfusion				
Yes	78	07	09	.238
No	72	03	4.2	

n : Number of infected case
% : Percentage
P : P value
UTI : Urinary tract infection

Table 6: Rate of hospital stay for different nosocomial infections.

		Hospital stay					
		<15 days			>15 days		
	Total	n	%	P	n	%	P
Superficial & Deep SSI	31	3	9.7	<0.05	28	90.3	<0.05
Organ space SSI	08	00			08	100	<0.05
Pneumonia	06	00			06	100	<0.05
UTI	10	06	100	.175	04	40	.175

n : Number of infected cases
% : Percentage
P : P value
SSI : Surgical site infection
UTI : Urinary tract infection

DISCUSSION

A total number of 150 cases underwent elective gastrointestinal surgery were analyzed in this observational study. The aim this study was to identify the association between serum total cholesterol level and nosocomial infection after gastrointestinal surgery. This study shows that there is an inverse relationship between serum total cholesterol level and postoperative nosocomial infections. Nosocomial infection rate is very high within those cases that have very low total cholesterol level. Morimoto m et al[5] shows that there is an inverse relationship between serum total cholesterol level and nosocomial infection after gastrointestinal surgery. Another study shows that hypocholesterolemia has also been associated with the development of nosocomial infections, especially during the postoperative period.[18]

In this study the incidence of nosocomial infection is found 36.7% (n=55) but there are many studies on nosocomial infections that show the incidence is not so high like this study. Ducel G et al[12] shows the incidence of nosocomial infection is about 10.3%. Another study shows incidence is about 14%.[5] There are several studies show different incidence of nosocomial infection.[19,20,21] Another study had been conducted in our country shows overall incidence of nosocomial infection is 29.6% which is more or less similar to this result.[22] This high incidence in this study may be due to inadequate maintenance of sterility in operation theater, use of instruments those are not properly sterilized, unjudicial use of antibiotics, mixture of infected and noninfected patients in same ward or it may be due to very small number of sample or very short period of study which may give faulty result.

This study shows very high incidence of superficial and deep SSI. It is about 20.7%. Superficial and deep SSI has very much significant relationship with low serum cholesterol level, low albumin level, and long operation time. Several study has shows that high incidence of SSI among nosocomial infection and inverse relation with cholesterol and albumin level. Preoperative hypoalbuminemia is well known to be significantly

associated with the development of postoperative SSI.[5,23,24]

Smoking is found as very strong risk factor for development of postoperative pneumonia and organ space infection. Some study shows same type of result that is smoking is associated with hospital acquired infection.[18,19] Organ space infection was also significantly associated with low serum cholesterol level, preoperative diagnosis and long operative period. In this study serum albumin level was not found as an indicator of development of postoperative organ space infection though several study shows inverse relation with serum albumin level and nosocomial infection.[25,26,27]

Increased age and smoking is found as strong predictor of nosocomial pneumonia. This study shows that patients aged >60 years were associated with development of pneumonia (20%). There are some research show the same type of result.[28] But in this study we found normal level of serum cholesterol level and low level of serum albumin level responsible for development of nosocomial pneumonia.

In this study I didn't find any significant association between postoperative UTI and preoperative total cholesterol and other variables except increasing age > 60 years though different study shows strong correlation with low serum cholesterol level and low albumin level.[5,23] In this study UTI is found 2nd most common occurring infection (6.7%).

In my study I didn't find any significant association between preoperative statin use and postoperative nosocomial infection though there is a study shows Prior therapy with statins has been associated with a significantly reduced risk of sepsis, including severe and fatal sepsis, and pneumonia.[29]

Significant mortality is seen in case of organ space infection though overall mortality rate is not so high (5.3%) in this study. Some study shows a very high mortality associated with hospital acquired infection.[30] Another study shows very low mortality.[5] In this study we can see that nosocomial infection significantly increase the length of hospital stay. Several studies show same type of result that mortality, cost, and length of stay were significantly higher in patients with HAIs compared with patients without HAIs.[14-17]

In my study I found that low level of serum total cholesterol level is associated with increased incidence of nosocomial infection, increased mortality, prolonged hospital stay and high level is protective. Several study shows similar result and there is some explanation how lower level is associated with increased rate of infection. First, Circulating cholesterol-rich lipoproteins and triglyceride-rich lipoproteins have the capacity to bind and detoxify bacterial lipopolysaccharide (LPS). HDL has been shown to compete with LPS binding protein (LBP) for binding to LPS. The LPS-LBP complex attaches to the CD-14 receptor on cells, which, in turn, stimulates TNF production. LDLs, VLDLs, HDLs, lipoprotein, triglycerides, and chylomicrons, can modulate the bioactivity of LPS. Second, cholesterol is the precursor of five major classes of steroid hormones. Cholesterol affects gluconeogenesis and immune function; its transport forms, the lipoproteins, also serve as vehicles for fat-soluble vitamins, antioxidants, drugs, and toxins. Cortisol levels are especially low in children with severe septic shock, which is not yet understood. High cholesterol may be protective, possibly through a beneficial influence on the immune system.

CONCLUSION

This study concludes that serum total cholesterol level is a strong predictor of postoperative nosocomial infection specially superficial and deep SSI, organ space SSI and pneumonia. There is an inverse relationship between serum total cholesterol level and nosocomial infection. Hypoalbunaemia and prolong operation time also significantly associated with nosocomial infection. Nosocomial infection cause increased mortality and prolonged hospital stay.

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