

Correlation Of Gallstone Disease With Iron-Deficiency Anaemia: A Prospective Study

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Citation

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Abstract

Gallstone disease is a common clinical entity affecting the adult population of both sexes. Conditions that favor the formation of cholesterol gallstones are super-saturation of bile with cholesterol, kinetically favorable nucleation and the presence of cholesterol crystals in the gall bladder long enough to agglomerate into a stone. Recent studies have defined the role of trace elements (Fe, Ca, Zn, and Cu) and defective pH in the formation of gallstones. The aim of the study was to correlate iron-deficiency anemia with gallstone disease. This prospective study of 100 patients was conducted over a period of 12 months in the Department of Surgery and Department of Biochemistry, Himalayan Institute of Medical Sciences, Dehradun, India. Serum and gallbladder biliary cholesterol levels were compared with gallstone patients having normal and low serum ferritin level. Gallbladder cholesterol level was significantly higher in anemic, than in non-anemic patients. Low serum iron level is a factor in bile super-saturation with respect to cholesterol leading to gallstone formation.

INTRODUCTION

Gallstone disease is a common clinical entity affecting the adult population of both sexes. The earliest known gallstones date back to the 21st Egyptian dynasty discovered in the mummy of a priestess of Amenemhat (1085-945 BC).

Gallstones are classified into either pure cholesterol stones, black or brown pigmented stones or mixed stones.

Conditions that favor the formation of cholesterol gallstones are super-saturation of bile with cholesterol, kinetically favorable nucleation and the presence of cholesterol crystals in the gall bladder long enough to agglomerate into stone. Recent studies have defined the role of trace elements (Fe, Ca, Zn, and Cu) and defective pH in the formation of gallstones. ^{1, 2}

AIM AND OBJECTIVE

The aim of the study was to correlate iron deficiency anemia with gallstone disease.

MATERIAL AND METHODS

The prospective study was conducted over a period of 12 months in the Department of Surgery and Department of Biochemistry, Himalayan Institute of Medical Sciences, Dehradun, India. The research committee of the institute approved the study protocol. One hundred patients suffering from cholelithiasis admitted in the surgical ward and

confirmed by ultrasonography were included in the study irrespective of their age, sex and parity. Both laparoscopic and open cholecystectomies were the procedures advocated for treatment. Patients suffering from empyema and mucocele of the gall bladder were excluded from this study. Serum iron, serum cholesterol and biliary cholesterol were estimated in all the patients.

Serum iron was estimated by Ferrozine kit method. ⁹ The normal reference values were supplied with the kit, for males (60-160 ug/dl) and for females (35-145 ug/dl). Serum cholesterol was estimated by Enzopak kit based on cholesterol oxidase/peroxidase method as devised by Allain et al. ¹⁰ Biliary cholesterol was estimated after extraction of biliary lipids from bile from the gallbladder specimen of the patients by the method of Folch et al. which was followed by the procedure similar to the analysis of serum cholesterol by Enzopak Kit to estimate the biliary cholesterol level. ¹¹

Based on the serum iron content, the patients with cholelithiasis were divided into two groups. Group A contained patients with normal serum iron and Group B iron deficient patients. Serum and biliary cholesterol contents of both groups were analyzed and compared with each other.

RESULTS

The gallstone sufferers were divided into two groups based

on the serum iron contents. Fifty-two percent of the patients fell in the non-anemic group (Group – A) while 48% fell in the anemic group (Group – B). (TABLE - 1)

Figure 1

Table 1: Serum Iron Contents In Groups A And B Gallstone Patients (n=100)

Sl. No.	Group	No. of patients	%	Serum Ferritin (ugm/dl)	
				Range	Mean \pm SD
1	A	52	52	40 - 150	131.6 \pm 8.2
2	B	48	48	5 - 40	25.2 \pm 7.1

The mean serum cholesterol value in Group A was 200.5 mg/dl and in Group B it was 202.3 mg/dl. (TABLE - 2)

Figure 2

Table 2: Serum cholesterol levels in group A and group B gallstone patients (n=100)

Sl. No.	Group	No. of patients	Serum cholesterol (mg/dl)	
			Range	Mean \pm SD
1	A	52	140 - 264	200.5 \pm 17.8
2	B	48	115 - 290	202.3 \pm 19.9

The mean bile cholesterol level in Group A was found to be 214.6 mg/dl and in Group B it was 375.3 mg/dl. The difference in values in both the groups was found to be statistically extremely significant ($p < 0.0001$), meaning thereby that the bile cholesterol of Group B patients was higher than that of Group A. (TABLE - 3), (FIGURE – 1)

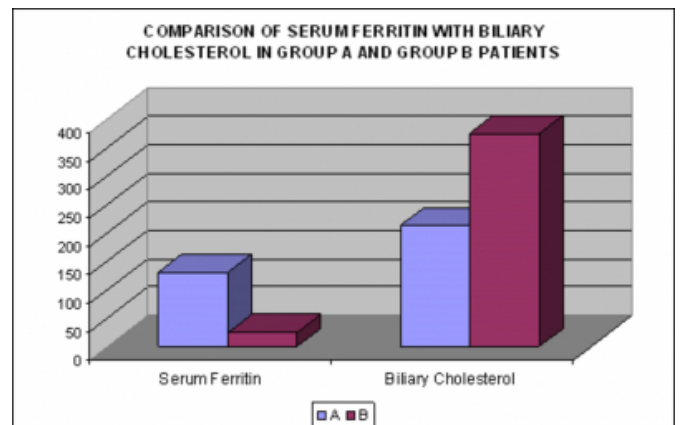
Figure 3

Table 3: Comparison Of Serum Ferritin With Biliary Cholesterol In Group A And Group B Patients (n=100)

Sl. No.	Group	No. of patients	Serum Ferritin (ugm/dl)		Biliary Cholesterol (mg/dl)	
			Range	Mean \pm SD	Range	Mean \pm SD
1	A	52	40 - 150	131.6 \pm 8.2	22 - 320	214 \pm 40.8
2	B	48	5 - 40	25.2 \pm 7.17	210 - 615	375 \pm 86.9

Figure 4

Figure 1



DISCUSSION

Iron deficiency has been shown to alter the activity of several hepatic enzymes leading to increased gall bladder cholesterol saturation and promotion of cholesterol crystal formation.^{3, 4} Iron acts as a coenzyme for nitric oxide synthetase (NOS) which synthesizes nitric oxide (NO) important for the maintenance of gall bladder tone and normal relaxation.^{5, 6} Alteration of motility of the gallbladder and sphincter of Oddi leading to biliary stasis resulting in cholesterol crystal formation has been reported with iron deficiency.⁷

The present study shows that the gall bladder bile cholesterol level was significantly higher in the anemic individuals, as compared to that of the non-anemic patients. Further, no significant variation in the serum cholesterol values was detected between the anemic group and the non-anemic group.

This study suggests that iron deficiency anemia is playing a significant role in the super- saturation of gallbladder bile with cholesterol and may act as an independent factor in formation of cholesterol gallstones. Defective hepatic cholesterol metabolism and stasis of bile because of decreased motility of the gall bladder can lead to more precipitation of cholesterol and hence formation of stone.⁸

CONCLUSION

Low serum iron level is a factor in the bile super-saturation with respect to cholesterol leading to gallstone formation.

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References

1. Strasberg SM, Clavien PA, Harvey PR. Pathogenesis of cholesterol gallstones. *HPB Surg* 1991; 3(2): 79-102.
2. Verma GR, Pandey AK, Bose SM, Prasad R. Study of serum calcium and trace elements in chronic cholelithiasis. *Aust NZ J Surg* 2002; 72: 596-9.
3. Roslyn JJ, Conter RL, Julian E, Abedin MZ. The role of dietary iron in pigment gallstone formation. *Surgery* 1987; 102: 327-33.
4. Johnston SM, Murray KP, Martin SA, Fox-Talbot K, Lipsett PA, Lillemoe KD, et al. Iron deficiency enhances cholesterol gallstone formation. *Surgery* 1997; 122: 354-61.
5. Swartz-Basile DA, Goldblatt MI, Blaser C, Decker PA, Ahrendt SA, Sarna SK. Iron deficiency diminishes gallbladder neuronal nitric oxide synthase. *J Surg Res* 2000; 90: 26-31.
6. Salomons H, Keaveny AP, Henihan R, Offner G, Sengupta A, Lamorte WW, et al. Nitric oxide and gallbladder motility in prairie dogs. *Am J Physiol* 1997; 272: G770-8.
7. Goldblatt MI, Swartz-Basile DA, Choi SH, Rafiee P, Nakeeb A, Sarna SK, et al. Iron deficiency transiently suppresses biliary neuronal nitric oxide synthase. *J Surg Res* 2001; 98:123-8.
8. Kumar M, Goyal BB, Mahajan M, Singh S. Role of iron deficiency in the formation of gall stones. *Indian J Surg* 2006; 68: 80-3.
9. Siedel J, Wahlefeld AW, Ziegenhorn J. A new iron Ferrozine reagent without deproteinization. *Clin Chem* 1984; 30: 975.
10. Allain CC, Poon LS, Chan CS, Richmond W, Fu PC. Enzymatic determination of total serum cholesterol. *Clin Chem* 1974; 20(4): 470-5.
11. Folch J, Lees M, Sloane Stanley GH. A simplified procedure for the extraction of cholesterol from human bile. *J Biol Chem* 1957; 226: 497-590.

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