Quantitative Analysis Of Copper And Zinc In Gallstone Patients

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Citation

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Abstract

INTRODUCTION: Gallstones affect 10% to 20% of the adult population worldwide. High levels of trace metals in patients of cholelithiasis may be associated with formation of gallbladder stones.AIM: To quantitatively analyse the levels of the trace metals copper and zinc in bile and serum of patients of gallbladder stones and normal population without stones.METHOD: Serum and bile obtained from 31 patients of gallbladder stones and 11 controls without stones were analysed for levels of copper, magnesium and zinc by atomic absorption spectrophotometer, make Perkin Elmer, Model AAnalyst 300.RESULTS: Copper level was increased in cases as compared to controls in both bile(3.91 times) and serum (1.25 times) when compared with each other. Zinc was 12.43 times more elevated in serum of cases than controls and 4.21 times in bile of cases than controls.CONCLUSION: Copper and zinc levels are increased in gallbladder-stone patients. There is increased excretion of copper in bile suggesting increased hepatic excretion in persons affected by gallbladder stones. There is an increase in the zinc level in serum leading to a secondary increase in the zinc level in bile in these cases.

INTRODUCTION

Gallstones are the most common biliary pathology. The vast majority of subjects (more than 85%) are asymptomatic[1]. There are several mechanisms in the formation of lithogenic bile – increased biliary secretion of cholesterol[2], nucleation of cholesterol monohydrate crystal[345] and decreased gallbladder motility[6]. It is largely the interplay between nucleating and anti-nucleating factors operating in bile that results in formation of gall stones. Various trace metals have been associated with stone formation.[78910111213] This study tries to correlate the occurrence of cholesterol and mixed gallstones with the level of various trace elements in bile and sera of gallstone affected patients and normal population.

MATERIALS AND METHODS

We studied 42 patients admitted to the Department of Surgery, Chhatrapati Shahuji Maharaj Medical University, Lucknow, Uttar Pradesh, India, for a period extending from September 2007 to 2008, of which 31 patients were cases of cholelithiasis and 11 were controls (without gallbladder stones). Blood (5 ml) samples were collected from cases and controls, after informed consent, by sterile disposable syringes from the cubital vein. During cholecystectomies, gallbladder bile was aspirated (5ml) and stored in glass vials. Bile (5 ml) was sampled from controls by aspiration technique using fine 23 gauge needles. The samples were transported within 6 hours to the laboratory at NBRI, Lucknow, India. Only those patients having cholesterol and mixed gallstones are included in this present study.

For digestion, 2 ml of sample (bile and blood separately) were mixed with 5 ml of conc. HNO3 in a pressure vessel. The vessels are made to run on the following program in a microwave digestion system[14]:

Figure 1

Step	I	II	III	IV	V
Temp °C	160	190	190	100	100
Pressure (bar)	30	30	30	1	1
Time (min)	5	5	10	10	10
Slope (min)	5	1	1	1	1
Power (%)	80	80	80	10	10

Serum/bile samples were filtered and made up to 50ml in 0.1N HCl. Quantitative estimation of copper and zinc was done on an Atomic Absorption Spectrophotometer (AAS, make Perkin Elmer, model AAnalyst 300). Results were analysed using correlation coefficients (r). The correlation coefficient shows the relationship between two variables;

positive r-value means that two variables increase or decrease in same direction and negative r-value means that two variables increase or decrease in opposite direction. An r-value of trace metals between bile and serum would suggest whether any increase of their level in bile is in proportion to their increase in serum or is independent of its serum level.

RESULTS

Figure 2

	Level in bile of cases*	Level in bile of controls	Level in serum of cases	Level in serum of controls	r-value of bile/serum in cases
COPPER	563	135	124	68	0.29
ZINC	1355	163	1748	123	0.46

*All levels are mentioned in microgram/dl.

The mean average level of copper in serum was 124 microgram/dl in the gallstone cases and 68 microgram/dl in controls (the normal copper level in serum is 70-140 microgram/dl[15]). The mean average level of copper in bile was 563 microgram/dl in cases and 135 microgram/dl in controls. The r-value of bile/serum levels in cases was 0.29. The mean average level of zinc in serum of cases was 1748 microgram/dl and in serum of controls it was 123 microgram/dl (the normal level of zinc in serum is 75-120 microgram/dl[15]).The mean average level of zinc in bile of cases was 1355 microgram/dl and in controls it was 163 microgram/dl. The r-value of bile/serum levels in cases was 0.46.

DISCUSSION

The level of zinc in serum of the gallstone cases was around 14 times higher than the level of zinc in serum of controls and the level in bile was around 8 times higher in cases than in controls. The r-value of the levels of zinc in bile and serum in cases is highly significant (0.46) suggesting that an increase in the level of zinc in bile is secondary to an increase in its level in serum.

Although the mean levels of copper in the serum of cases and controls were within normal ranges, the levels were increased in cases as compared to controls.

The mean average level of copper in bile in cases was 4.17 times more than the level in controls. An r-value being not highly significant and levels of copper in serum being in the normal ranges in both cases and controls suggest that the copper level is increased in bile due to active secretion into the bile by the liver. Copper in the body is partly excreted by the liver through bile and it is probable that there is an increase in hepatic excretion of copper in persons predisposed to gallstone formation.

CONCLUSION

The presence of trace metals in lithogenic bile has been proven by various studies. Atomic absorption spectroscopy of bile and serum from gallstone cases showed increased levels of both copper and zinc in our study compared to controls, further confirming such a theory. Research done on gallstones has shown incorporation of trace elements like copper and zinc in the crystalline structure of gallstones[16171819]. Variations in the trace metal characteristics of bile and serum composition between geographical locations may be responsible for differences in rates of gallstone incidence among various locations. Correlations between soil and water levels of minerals and trace elements need to be performed in areas of high gallstone incidence.

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