EFFECT OF PARTIAL ILEAL BYPASS ON THE LIPID PROFILE IN THE HYPERLIPEDEMIC RABBITS

U. K. SHRIVASATAVA*, V. R. MINOCHA, RIMI SHUKLA**, DINESH KUMAR AND O. P. TANDON***

Departments of *Surgery, **Biochemistry and ***Physiology, University College of Medical Sciences and Guru Tegh Bahadur Hospital, Delhi – 110 095

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Abstract: The hypocholesterolemic effect of partial ileal bypass was studied in two groups of healthy albino rabbits. Both groups of rabbits were made hypercholesterolemic by feeding them cholesterol suspended in groundnut oil (1 ml/kg bw) at a dose of 100 ml/kg bw/day for one week. Group I rabbits were subjected to partial ileal bypass and group II rabbits were sham operated. Weekly estimation of serum lipid profiles were done for four more weeks while continuing cholesterol feed. After end of 5th week, it was found that partial ileal bypass not only prevented but also brought down its level from 132.8 mg% to 44.8 ± 2.24 mg%, as compared to sham operates group where cholesterol level was 279 ± 5.84 mg%. There was improvement in other parameters of lipid profiles namely HDL-C & LDL-C + VLDL-C and TAG.

Key words: hyper lipidaemia ileal bypass lipid profile

INTRODUCTION

Atherosclerosis is a well-known Cardio-Vascular disorder responsible for high rate of mortality and morbidity. Along with vascular endothelial dysfunctions elevation of serum cholesterol is one of the major factors, causing an increased risk of development of atherosclerosis. The risk of atherosclerosis rises steadily with the increased serum cholesterol concentration above 220 mg/dl.

Serum cholesterol comprises low-density cholesterol (LDL-C), high-density cholesterol (HDL-C) very low-density cholesterol (VLD-C) and Triacylglycerol (TAG). High levels of LDL-C is directly associated with atherosclerosis while HDL-C is protective against it i.e. higher the mean level of HDL-C in a group of individuals, lower is the incidence of atherosclerosis in that group (1). A level of HDL-C more than 32 mg/dl or a total cholesterol/HDL-C ratio less than 3.5 is found to be associated with lower incidence of atherosclerosis. The probable explanation for beneficial role of HDL is in its removal of cholesterol from peripheral tissues and its return for excretion to liver. HDL-C may also inhibit
platelet function or protecting against lipid peroxidation (2). No prospective trial has yet been attempted to increase serum HDL-C with aim of reducing Coronary Heart Disease (CHD) risk. Overall a 1 mg/dl increase in HDL-C will reduce CHD risk by various therapeutic modalities that have been used to lower the plasma concentrations of cholesterol with the goal of reducing the risk of atherosclerosis related cardiovascular disease (3). Of these, dietary modification and pharmacological intervention are the most important therapeutic regimen.

Because hypercholesterolemia is not an acute and transitory disease state, its therapy must be lasting and without evidence of therapeutic escape or lipid level rebound. Because the therapy must last a lifetime it should have minimum side effects and minimum economic burden to patient. Hence other regimen based on least abberation of the physiological principles have to be evolved.

The rationale of surgical approach is to interfere with the enterohepatic cholesterol and the enterohepatic bile acid cycles. This achieves:–

i) A direct loss of cholesterol from the body.

ii) An indirect cholesterol drain by the forced conversion of part of the cholesterol pool to bile acids.

Physiological cholesterol enters the intestinal tract by ingestion and by endogenous secretion via the bile and intestinal mucosa. It is absorbed exclusively in the ileum and preferentially in the distal half (5). Partial ileal bypass leads to hypolipidemia through a two-fold drain on body cholesterol pools. A direct drain results from increased faecal loss of normally absorbed exogenous (dietary) and endogenous (biliary) cholesterol. Indirect drain results from the compensatory increase in hepatic conversion of body cholesterol to bile salts to maintain normal bile levels.

Buchwald (7) did reversal of the continuity of jejunal and ileal segments but found no change in total cholesterol absorption even though due to the length of emulsification process the ileum was now exposed to a relatively smaller fraction of absorbable cholesterol in comparison to the jejunum. Jejuno-ileal bypass (90% of small intestine) had been tried to control hypercholesterolemia but about 5% of these patients developed hepatic degeneration (6).

Buchwald Henry (8) showed that feeding a group of rabbits pellet chow impregnated with cholesterol (2% by weight) for four months raised the average blood cholesterol concentration to 1,265 mg% and produced severe atherosclerotic lesions with an associated 50% myocardial infarction rate (7-8). In another group of rabbits subjected to ileal bypass and then placed on identical diet, there was no elevation in the cholesterol concentration; indeed the average circulating cholesterol level was below that of a control group (8-9).

We performed the present study to confirm the results in a larger number of rabbits (forty) and control group was also subjected to sham operation to exclude the cholesterol lowering effect of operative stress. We also studied the effect of partial ileal bypass on serum LDL-C, VLDL-C, HDL-C, TAG.
METHODS

The study was done is forty healthy albino rabbits weighing 1-2 kg. Rabbits were acclimatized to laboratory conditions for ten days before starting the experiment. After twelve hours of fasting blood samples through the ear veins of rabbits were collected in order to estimate the baseline serum lipid profiles which included total cholesterol, HDL-C, LDL-C, TG and VLDL-C.

Induction of hyperlipidemia: The rabbits were divided into test and control groups of twenty each with uniform weight distribution. They were made hypercholesterolemic by method described by Shukla et al (9). All the rabbits were given 100 mg per kg body weight per day of cholesterol orally suspended in ground-nut oil (1 ml/kg b/w) to induce hypercholesterolemia. After one week of cholesterol feeding the blood samples of all the rabbits were collected to confirm the rise in cholesterol level (after overnight fasting). Then the rabbits of test group were subjected to partial ileal bypass and control group were subjected to sham operation.

Partial ileal bypass operation: After overnight fasting rabbits were anaesthesized after giving intra-peritoneal thiopentone (2.5% w/v) at dosage of 100 mg/kg b.w. In this surgery the distal half of the ileum which is the most absorptive area was disrupted from the proximal half. The proximal ileum was anastomosed to the caecum.

Sham operation: Laparotomy was done by midline abdominal incision under intraperitoneal thiopentone anaesthesia and without handling intestine, abdomen was closed.

Estimation of lipid profile was done weekly in both test and control groups (i.e. at 0, 1, 2, 3, 4 & 5 weeks). Serum cholesterol, HDL-C and TAG were estimated by enzymatic method using kits from orthodiagnosis. LDL-C was calculated using Friedal Wald's formula.

RESULTS

Total serum cholesterol of both groups was similar (33.8 + 2 mg% and 32.9 + 1.4 mg%) to start with, which increased to 132 + 3.1 mg% in both groups after one week of high cholesterol diet. There was a continuous fall of serum cholesterol seen in test group. The value of serum cholesterol after 5 weeks was 44.8 + 2.24 mg% while in control group it was 280.24 + 5.84 mg (Fig. 1).

Fig. 1: Bar Diagram Showing effect of partial ileal bypass on total cholesterol level.

The average triacylglyceride (TAG) in test group was 72 + 1.82 mg% at zero week which increased to 95 mg% after one week but later there was continuous fall in serum TAG level (75.2 ± 1.82 mg%) after five weeks inspite of continuous supply of cholesterol feed. In control group the arithmetic mean of TG was 74 ± 1.57 mg% at zero week and increased to 199.3 ± 3.58 mg% after 5 weeks (Fig. 3).
HDL-cholesterol in test group and control group was $15 \pm 0.96 \text{mg}\%$ and $15 \pm 1.006 \text{mg}\%$ respectively at zero week, which increased to $22.7 \pm 1.66 \text{mg}\%$ in test group, and $22 \pm 1.44 \text{mg}\%$ in control group after five weeks (Fig. 2).

The serum lipid profile of both the groups of rabbits was more or less the same to start with. The degree of hypercholesterolemia and associated hyperlipoproteinemia was also same in both groups by the end of first week in preoperative period.

The increase of total cholesterol was 3–4 times the baseline value because of high cholesterol diet. The increase in TG was due to groundnut oil feed. In the test group total cholesterol showed a decline in level from 132.3 mg% at one week to 44.8 ± 2.24 mg% after five weeks while in control group it increased from 132 mg% at zero week to 279 ± 5.84 mg% after 5th week.
Similar results were found in VLDL-C + LDL-C level in both the groups. In test group LDL-C + VLDL-C levels were 113.2 mg% at 1st week and decreased to 22.32 ± 3.32 mg% after 5 weeks while in control group the levels increased from 112.6 mg% to 260 ± 13.06 mg% in the same duration.

No significant change in the levels of HDL-C was found in both the groups. Although the ratio of LDL-C + VLDL-C to HDL-C showed a remarkable improvement. This ratio at zero week was 2.25 in test group and 2:19 in control group. In test group this decreased to 1.97 after partial ileal bypass while in control group it is increased to 12.72 after sham operation.

It is concluded from the experiment that partial ileal bypass is a effective mean of controlling hyperlipidemia contrary to the results of drug therapy, the cholesterol lowering effects of partial ileal bypass is lasting. There has been no chance of response escape. Patients may or may not adhere to diet, may or may not take pills. This surgical ileal bypass procedure when applied to humans, would prove its effectiveness in lowering cholesterol despite the fact that once operation is performed its therapeutic effects would be maintained and obligatory. Besides two fold drain of body cholesterol pool, the other neuroendocrinal mechanism may also be involved in producing cholesterol lowering effect. Removal of neuro-endocrinal signals from the bypassed terminal ileal portions, might affect the lipid metabolism in general and cholesterol pathway in particular. Future studies in this direction will reveal the exact interactions resulting in lipid lowering effect.

REFERENCES


