Liver Function Tests in Surgical Infection and Malnutrition

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Liver function tests were studied in chronically infected surgical patients, patients who recovered from infection, nonseptic malnourished patients and healthy control subjects. Liver function tests were abnormal in the septic patients but returned to normal values upon recovery from infection despite persistent loss of body weight. Malnourished, nonseptic patients similarly had normal liver function tests. These findings suggest that infection rather than accompanying malnutrition is the major cause of the abnormal liver function tests commonly observed in chronically septic surgical patients. Standard liver function tests may be helpful both in the diagnosis of occult intra-abdominal sepsis and also in indicating the efficacy of its treatment.

ABNORMAL LIVER FUNCTION tests are often present in seriously ill surgical patients. Possible factors include hypoxia and trauma,[1] extrahepatic infection,[2] malnutrition[3] and parenteral nutrition.[4] The purpose of this study was to attempt to distinguish between the effects of chronic infection and those of malnutrition on liver function tests. Infection and malnutrition commonly occur in combination. Malnutrition predisposes to infection and infection may turn borderline nutritional deficiencies into severe malnutrition.[5]

Patients and Methods

Ten patients (eight male, two female) with major intra-abdominal or intrathoracic infection (five subphrenic, four pelvic abscesses, one empyema) were studied. Infection had been present for between one and two weeks duration. All patients were clinically malnourished and had lost body weight (Table 1). Five patients had carcinomas (three colon, one stomach and one pancreas). Evidence of infection was both radiologic, the presence of discharging pus, a swinging pyrexia, raised white blood cell count (Table 1) and bacterial culture of pus obtained at laparotomy or from drain sites. Infecting organisms were Coliform in five patients, coliform and *Bacteroides* sp. in two patients and coliform and *Pseudomonas* sp., *Pseudomonas* sp. and *Staphylococcus aureus* in one patient each. Three patients died and four were studied again six to twelve weeks later when there was no clinical, hematologic or radiologic evidence of infection.

Ten clinically malnourished patients (eight male, two female) who had lost approximately 20% of their normal body weight but who were not infected (Table 1) were also studied. Two of these patients had carcinomas of the esophagus and two had benign esophageal strictures. Three patients had a gastric carcinoma, two benign pyloric stenosis and one malabsorption. No patients were clinically dehydrated, edematous or had clinical or hematologic evidence of infection. Triceps skin fold thickness and arm muscle circumference were measured by standard methods.[6] Weight-loss was calculated from tables of average weight for age, sex and height (Geigy Scientific Tables 1970).

Ten well-nourished nonseptic patients (seven males, three females) who were of similar age distribution to the other groups, were studied as control subjects. Three patients had a duodenal ulcer, three patients had gallstones, two patients had carcinoma of breast, one patient had hemorrhoids and one patient had rectal prolapse.

No patient had a previous history of liver disease, evidence of hepatic metastases or intrahepatic abscesses at laparotomy or on technetium-99m liver scan. None had received drugs known to cause cholestasis and no patients had received parenteral nutrition, suffered hypotension or hypoxia or had undergone surgery within one week of study. Five patients in control, septic and malnourished groups were studied preoperatively and five postoperatively. Patients in both the septic and malnourished groups had a calorie intake of less than 1000 kcal (4.2 Megajoules) per day for the week prior to study.

Liver Function Tests

Following a 12-hour overnight fast 15 ml blood was taken without stasis from an arm vein for the determination of plasma albumin, cholesterol, bilirubin, alkaline phosphatase, glutamic oxaloacetic transaminase (GOT) and urea concentrations by a Technicon® SMA 12/60

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TABLE 1. *Age, Body Weight, Weight-loss, Hemoglobin Concentration and White Blood Cell Count*

Group	Age (yr)	Weight (kg)	Weight-loss (%)	Hb (g%)	WBC ($\times 10^9$/L)
Control (n = 10)	60 ± 2	69 ± 5	3 ± 5	13.6 ± 1.3	7.1 ± 0.4
Septic (n = 10)	55 ± 5	59 ± 3	18 ± 4*	11.7 ± 1.4†	13.2 ± 1.8†
Septic recovered (n = 4)	56 ± 4	56 ± 4	21 ± 7*	13.4 ± 0.7	8.6 ± 0.2
Malnourished (n = 10)	62 ± 5	50 ± 4†	26 ± 4†	11.3 ± 0.4†	9.0 ± 2.0

* $p < 0.05$; † $p < 0.02$ (probabilities compared with controls).

autoanalyzer. Blood hemoglobin concentration and white cell count were determined by a Coulter Counter.

Statistics

Data were compared by Student's t-test but when variances showed that the data were nonhomogenous as determined by the F-test, the Mann-Whitney U-test was employed. All results are expressed as mean ± SEM.

Results

Both septic and nonseptic malnourished patients were elderly and had lost weight. (Table 1). Further evidence for malnutrition in the nonseptic group was reduced triceps skin fold thickness (43 ± 10% of controls) and decreased arm muscle circumference (85 ± 4% controls). Despite clinical recovery from infection, septic patients still had loss of weight several months later.

Both septic and malnourished patients had low hemoglobin concentrations compared with control subjects (Table 1) and septic patients had a leucocytosis. The patients with sepsis, however, unlike the malnourished subjects had lower plasma concentrations of albumin and cholesterol and increased concentrations of alkaline phosphatase and GOT compared with controls (Table 2). Following recovery from infection, liver function tests in the septic group returned to normal. Plasma urea concentrations were similar in all groups of patients.

Discussion

There have been few studies of liver function tests in noninfected malnourished surgical patients. Plasma albumin concentration has been reported[7] to be decreased in surgical malnutrition but 15 of the 27 malnourished patients reported with low plasma albumin concentrations also had intra-abdominal sepsis. Fatty infiltration of the liver and changes in blood concentrations of hepatic enzymes and bilirubin have been reported in children suffering from malnutrition.[3] The majority of these children however probably also had accompanying infection or parasitic infestations.

The present study of surgical patients compares liver function tests in both infected and noninfected malnourished subjects. In particular, no patients had received parenteral nutrition which is associated with abnormal liver function tests.[4]

Liver function tests in the septic patients were abnormal while values were similar to control subjects in both the patients who recovered from infection and also in the noninfected malnourished patients. The patients who had recovered from infection also had not regained normal body weight. These findings strongly suggest that infection rather than inadequate food intake is the cause of abnormal liver function tests in chronically septic surgical patients. Further evidence for infection as the caused of the abnormal liver function tests is provided by the changes in hepatic function and histology caused experimentally by endotoxin[8] and the changes in liver function tests that result from the infusion of *Corynebacterium parvum* in man.[9] Noninfected malnourished patients in the present study were not edematous and their normal plasma albumin concentrations are similar to those found in children with marasmus.[10]

In conclusion, it would seem wise to carefully exclude infection in ill surgical patients who are at risk from sepsis and who develop abnormal liver function tests. Changes in these routine tests may be helpful in the diag-

TABLE 2. *Liver Function Tests*

Group	Albumin (g/L)	Cholesterol (mmol/L)	Bilirubin (μmol/L)	Alk. Phos. (iu/L)	GOT (iu/L)	Urea (mmol/L)
Control (n = 10)	40 ± 1	5.3 ± 0.5	11 ± 1	61 ± 8	46 ± 11	4.6 ± 0.5
Septic (n = 10)	29 ± 2*	3.2 ± 0.4†	52 ± 40	220 ± 95*	70 ± 12*	4.8 ± 0.8
Septic recovered (n = 4)	38 ± 1	5.0 ± 0.8	9 ± 2	60 ± 21	25 ± 21	4.3 ± 1.1
Malnourished (n = 10)	37 ± 3	4.6 ± 0.7	10 ± 3	119 ± 54	48 ± 13	5.0 ± 1.0

* $p < 0.02$; † $p < 0.01$ (probabilities compared with controls).

nosis of occult intra-abdominal or intrathoracic sepsis which may require surgical drainage. Following recovery from infection, liver function tests return to normal. This may be useful in judging the efficacy of treatment of sepsis. Malnutrition alone is unlikely to be the cause of alterations in routine liver function tests in surgical patients.

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