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Short Report

Age-related Changes in Serum Lipids and Longevity in Hepatectomized Rats

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Abstract

The life span and serum lipids of Sprague-Dawley rats was examined following partial hepatectomy. Adult Sprague-Dawley rats were divided into two groups. One group received a 30% partial hepatectomy (30H) and the other underwent sham-surgery(control). Moreover, group 30H rats were divided into two subgroups based on length of survival ; a short life span group (30HS, n=4), and a long life span group (30HL, n=4). Blood was collected at 24 weeks after partial hepatectomy, and effects on serum biochemical parameters and longevity were evaluated. The 30HS group gained weight more rapidly than the 30HL group. Serum lipids in the 30HS group were higher than those in the 30HL group. These results indicate that survival rate may be related to early changes in lipid metabolism after partial hepatectomy.

Introduction

An essential prerequisite for successful partial liver transplantation is to perform donor hepatectomy with minimal risk[1]. Such procedures involve a left lateral lobectomy in the donor, since it is less hazardous, full vascular occlusion of donor livers is not necessary, and the risk of complications to the donor are reduced[2]. Provided the hepatic remnant is composed of relatively normal tissue, parenchymal regeneration usually begins almost immediately[3]. Two to three weeks post surgery, hepatic function normally returns to preresection levels, although a total of three or four months is required for enlargement of the liver mass to preoperative size[4].

Recently, there have been reports on bacterial or endotoxin translocation following hepatectomy[5] and Bengmark et al. reported that rats subjected to partial hepatectomy rapidly developed fatty livers[6.7]. For these reasons, the most conservative resections possible should be performed in patients. However, there are few reports that changes in the regenerating liver can prove to be fatal. This study compared the life span and blood biochemical data of partially hepatectomized and normal rats.

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Material and Methods

Animals

Male Sprague-Dawley rats weighing 500±5g were used in this experiment. Animals were housed in a temperature controlled room with a 12h light/dark cycle.

Experiment 1: Longevity

The animals were divided into two groups: a 30% partial hepatectomy group(30%H, n=7) and a sham-operated control group(n=9). After an overnight fast, the rats were anesthetized with an intraperitoneal injection of sodium pentobarbital, Nembutal, and the abdomen was opened with an upper midline incision. Controls were closed immediately. In the 30%H group, the left lateral lobes (30 % of the total liver volume) were resected according to the method described by Higgins and Anderson[8]. After a two-day fast, water and a standard pellet diet were made available *ad libitum*. Daily changes in body weight were recorded during the experimental period. The average longevity for the 30 %H group was compared with that of the control group. Moreover the 30%H group was divided into two subgroups based on longevity, a short life span group(30HS) and a long life span group(30HL).

Experiment 2: Chemical analysis of blood

Blood was collected from the tail vein under light ether anesthesia at 24 weeks. The serum parameters were assayed with an automatic analyzer(Hitachi, Model 7170).

The serum lipid parameters measured were triglycerides(TG), free fatty acids(FFA), total cholesterol(TC), esterified cholesterol(EC) and free cholesterol(FC).

Statistics: Differences were analyzed by Student's t-test, and $p<0.05$ was considered significant.

Results and Discussion

We previously reported that the survival rate of the 30%H group was significantly lower than that of the control group, and partial hepatectomy affected serum lipid levels[9]. However, the reasons for differences in survival rate were not clear. For analytical purposes, the 30%H group was divided into two subgroups depending on longevity ; 30HS （shorter lifespan） and 30HL (longer lifespan).

Figure 1 shows the growth curve post operatively for each subgroup. The rats in the 30HS group gained weight more rapidly than did those in the 30HL group. The TC, EC, FC, TG and FFA data are presented in Fig.2. The TC, EC, FC, TG and FFA levels of the 30HS group showed increase at 24 weeks after surgery. The serum lipid in the 30HS group were higher than those in the 30HL group. The food intake data in Fig.3 shows that the 30HS group consumed more than the 30HL group. There was a significant difference between the experimental subgroups. During the rapid regrowth phase, lipid synthesis was increased in regenerating livers compared with those of the sham-operated controls[10] when expressed in terms of the whole liver. Bengmark et al. reported that rats subjected to partial hepatectomy rapidly developed fatty livers. Several factors have been proposed to contribute to this phenomenon, including excessive

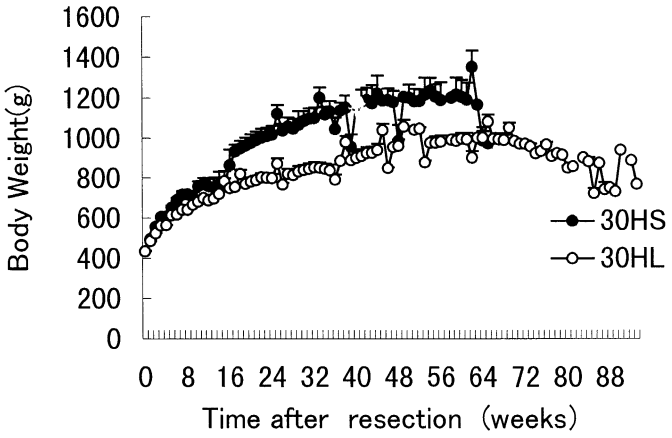

Fig. 1 A comparison of body weight changes between the 30HS and 30HL groups. All values are expressed as means ± SEM.

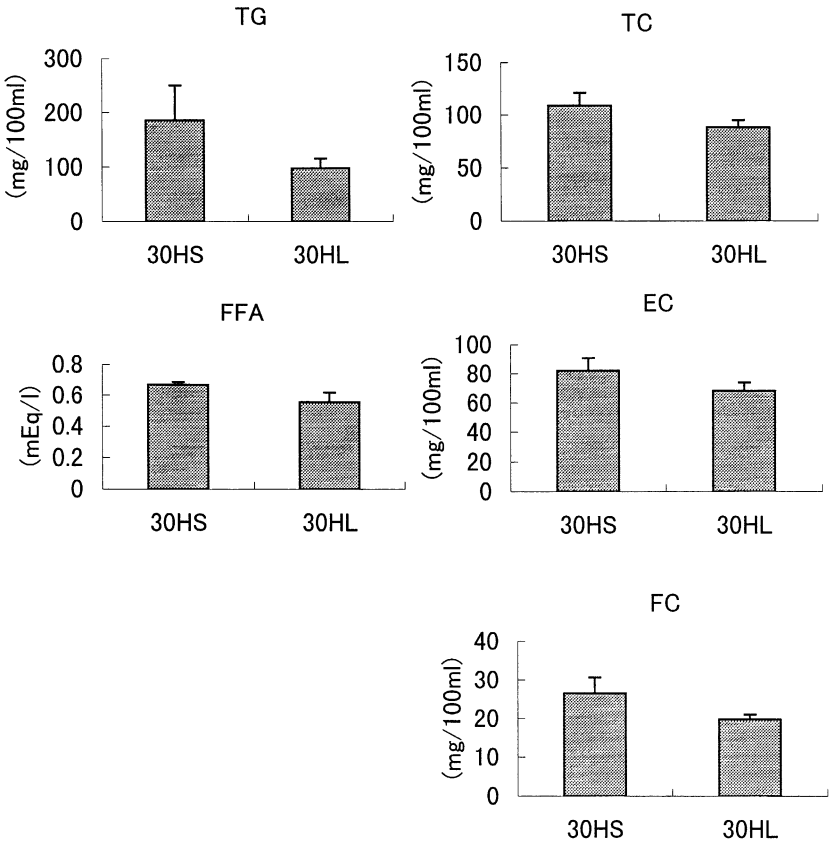

Fig. 2 A comparison of serum TG, TC, FFA, EC, and FC levels between 30HS and 30HL rats. Values are expressed as means ± SEM.

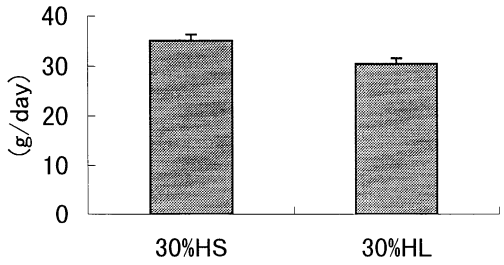

Fig. 3 A comparison of food intake levels of the 30HS and 30HL groups 24 weeks post surgery. Values are expressed as means ± SEM.

increase of the rate of fatty acid synthesis, highly elevated mobilization of fatty acids from the adipose tissue, impaired secretion of lipoproteins by the liver, and increased channeling of fatty acids into liver triacylglycerol[11]. These are some of the earliest and most striking changes found in the regenerating liver after partial hepatectomy. The survival rate in the present experiment may be related to early changes in lipid metabolism after partial hepatectomy. Weight gain, increased food intake and increase serum lipids may contribute to death. Moreover, it was hypothesized that minimizing the increase in BW is essential for lengthening the life span of the rat, since the 30HS group gained considerable weight post operatively. It is necessary to examine the growth rate and life span of 30%H rats under restrictive feeding conditions.

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