

Research Article

H-Ras Oncogene Expression and Angiogenesis in Experimental Liver Cirrhosis

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Background. Proto-oncogenes, particularly ras, may not only affect cell proliferation but also contribute to angiogenesis by influencing both proangiogenic and antiangiogenic mediators. The aim of this study was to investigate whether any relationship exists between ras expression and angiogenesis during diethylnitrosamine- (DEN-) induced experimental liver fibrosis. **Materials and Methods.** Liver cirrhosis was induced in rats by intraperitoneal injections of DEN. The animals were sacrificed 2 weeks after the last administrations and a hepatectomy was performed. Masson's trichrome staining was used in the evaluation of the extent of liver fibrosis. The vascular density in portal and periportal areas was assessed by determining the count of CD34 labeled vessel sections. For quantitative evaluation of H-ras expression, in each section positive and negative cells were counted. **Results.** In fibrotic group H-ras expression was higher than that in nonfibrotic group and was more widespread in cirrhotic livers. Friedman's test showed that there was a significant correlation between H-ras expression and VD ($P < 0.01$). **Conclusion.** The results of this descriptive study reveal that H-ras expression gradually increases according to the severity of fibrosis and strongly correlates with angiogenesis.

1. Background

Proto-oncogenes, particularly ras, may not only affect cell proliferation but also contribute to angiogenesis by influencing both proangiogenic and antiangiogenic mediators [1, 2].

Recently the close association of fibrogenesis and angiogenesis during liver injury has been demonstrated and it has been proposed that its manipulation could be promising in the treatment of chronic liver diseases which respond poorly to conventional therapies [3].

Numerous studies have shown increased ras expression in experimental models and in liver specimens from cirrhotic patients of different etiologies. It has been proposed that increased expression of ras in cirrhotic livers might be associated with inflammation and fibrosis, besides its suggested role in the early step of hepatocarcinogenesis [4]. However the relationship between ras expression and angiogenesis during liver fibrogenesis has not been documented.

Therefore, the aim of this study was to investigate whether any relationship exists between ras expression and angiogenesis during diethylnitrosamine- (DEN-) induced experimental liver fibrosis.

2. Methods

Liver cirrhosis was induced in rats by intraperitoneal injections of DEN (Sigma, Saint-Quentin-Fallavier, France) at 100 mg/kg of body weight ($n = 24$) or 0.9% sodium chloride ($n = 6$) once a week. The injections were applied for 2 ($n = 4$), 4 ($n = 4$), 5 ($n = 4$), 6 ($n = 4$), 8 ($n = 4$), and 10 ($n = 4$) weeks. The rats were sacrificed 2 weeks after the last applications and hepatectomies were performed. Liver tissue samples were fixed in 10% buffered formalin and embedded in paraffin.

Four-micrometer-thick sections were prepared and stained with hematoxylin-eosin and Masson's trichrome

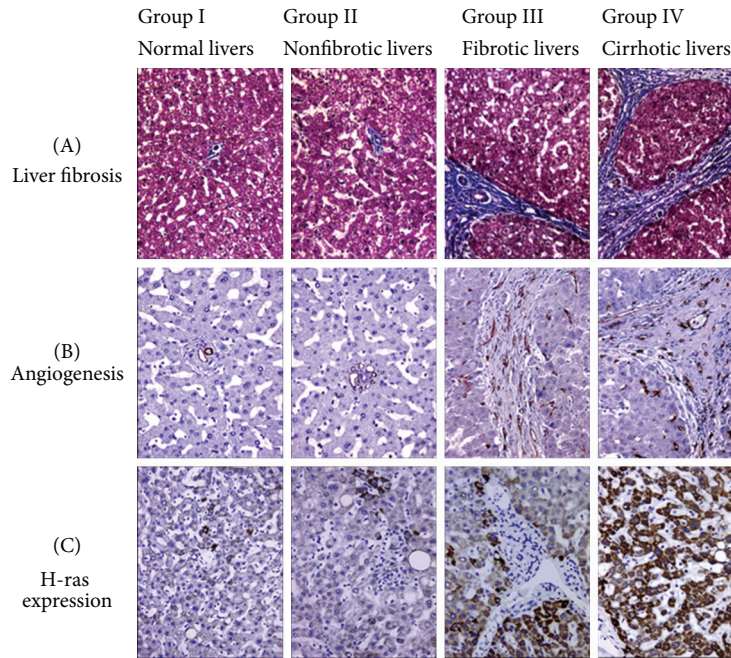


FIGURE 1: Liver fibrosis (A), angiogenesis (B), and H-ras expression (C) in the study group. In normal livers, the number of CD34 labeled vessels* and H-ras positive cells* is lower when compared to DEN-treated livers. In the latter, their number increases according to the extent of fibrosis (*brown color staining).

TABLE 1: Distribution of mean, standard deviation (SD), median, and ranges of vascular density (VD) and H-ras expression in normal livers (group I), nonfibrotic (group II), fibrotic (group III), and cirrhotic livers (group IV). The Mann-Whitney *U* test was used.

Group	VD				H-ras (%)			
	Mean \pm SD	Median	Range	<i>P</i>	Mean \pm SD	Median	Range	<i>P</i>
I (<i>n</i> = 6)	3.1 \pm 0.95	3	0–7	>0.05	0.66 \pm 0.58	0	0–4	>0.05
II (<i>n</i> = 8)	6.82 \pm 2.5	7	2–11	<0.05	13 \pm 6.08	12	3–30	<0.05
III (<i>n</i> = 8)	11.3 \pm 2.4	10	9–16	<0.05	19.6 \pm 6.39	22	10–30	<0.05
IV (<i>n</i> = 8)	15.90 \pm 3.7	16	10–22	<0.05	25.87 \pm 7.28	26	12–30	<0.05

for the histopathological assessment and the evaluation of the extent of liver fibrosis. Immunolabeling was performed using monoclonal antibodies directed anti-rat CD34 (dilution: 1: 500, Santa Cruz, CA, USA) and H-ras (dilution: 1: 200, Santa Cruz, CA, USA). An avidin-biotin-peroxidase technique (sc-2023, anti-goat ABC staining Kit, Santa Cruz, CA, USA) was used for labeling.

The vascular density in portal and periportal areas was assessed by determining the count of CD34 labeled vessel sections at higher magnification ($\times 400$), with the use of an ocular grid subdivided into 100 areas. For each subject vascular density (VD) was noted.

For quantitative evaluation of H-ras expression, in each section positive and negative cells were counted in systematically randomly selected 10 to 15 microscopic fields by using an ocular grid at high magnification ($\times 400$). The positive staining was calculated as the percentage of positive cells to total number of counted cells. Positive cells touching the left and lower edges of the grid were not included.

All analysis was performed by using Statistical Package for Social Science (SPSS 15.0 for Windows, USA). The Mann-Whitney *U* test was used to establish the difference between groups. Friedman's test was used to determine the relationship among quantitative parameters. Data were expressed as mean \pm SD and *P* < 0.05 was considered significant.

3. Results

In this study, fibrous septa formation was detected after 5 weeks and the liver was cirrhotic in all cases after 8 weeks. In the control group any fibrosis was not detected. In respect of the grade of fibrosis, cases were divided into the following groups: group I: normal livers, group II: nonfibrotic livers (2 and 4 weeks), group III: fibrotic livers (5 and 6 weeks), and group IV: cirrhotic livers (8 and 10 weeks) (Figure 1 and Table 1).

While in control (group I) CD34 staining was restricted to the endothelium of portal vessels, numerous CD34-labeled

vessels were detected in fibrotic and cirrhotic livers (Figure 1). The latter CD34 staining revealed a dense vascular plexus surrounding the cirrhotic nodules. In nonfibrotic livers (group II) CD34 expression was noted in a few vascular structures around portal areas. Parallel to these findings, VD values were increased together with the progression of fibrosis (Figure 1). Groups II, III, and IV had higher VD than the control group ($P < 0.05$). The difference among VD values of these groups was also statistically significant ($P < 0.05$) (Figure 1 and Table 1).

H-ras expression was observed in the cytoplasm of the hepatocytes. In normal livers (group I), the expression was restricted to a few periportal hepatocytes. However in DEN-treated rats H-ras expression displayed a heterogeneous distribution. In fibrotic group (group III) H-ras expression was higher than that in group II and was more widespread in cirrhotic livers (group IV) (Figure 1). The expressions of H-ras in DEN-treated rat groups were significantly different from each other ($P < 0.05$) (Figure 1 and Table 1). Moreover, Friedman's test showed that there was a significant correlation between H-ras expression and VD ($P < 0.01$).

4. Conclusion

The results of this descriptive study reveal that H-ras expression gradually increases according to the severity of fibrosis and strongly correlates with angiogenesis.

Our data suggest that H-ras might contribute to the wound healing response to liver injury not only as a strong activator of hepatic stellate cells leading to fibrosis but also as an inducer of angiogenesis.

In the light of these observations, it would be of interest to evaluate the mechanism triggered by H-ras in hepatic angiogenesis with further experimental models, in order to completely clarify if the use of ras inhibitors would be beneficial in multitargeted treatment of fibrogenesis in chronic inflammatory liver diseases ending with cirrhosis.

Acknowledgment

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