

CHAPTER III

RESULTS

In order to see the possibility of difference among controls, primary liver cell carcinoma and other liver diseases. The subjects were grouped into three categories. In the first category there were three groups of subjects: controls, other liver diseases than primary liver cell carcinoma (amoebic liver abscess, cirrhosis of the liver, cholangiocarcinoma and carcinoma of the head of pancreas) and primary liver cell carcinoma (Table 1, 2). In the second category there were four groups of subjects: controls, amoebic liver abscess, obstructive jaundice (cholangiocarcinoma and carcinoma of the head of pancreas) and primary liver cell carcinoma (Table 3, 4). There were six groups of subjects in the third category: controls, amoebic liver abscess, cirrhosis of the liver, cholangiocarcinoma, carcinoma of the head of pancreas and primary liver cell carcinoma (Table 5, 6).

Prealbumin, albumin, α_1 -acid glycoprotein and transferrin (PAGE) in each category are shown in Table 1, 3 and 5 whereas haptoglobin, α_2 -macroglobulin, ceruloplasmin, α_2 HS-glycoprotein, hemopexin, Gc-globulin and transferrin (rocket immuno-electrophoresis) are shown in Table 2, 4 and 6. The comparison of proteins in each group of patients and controls of the three categories are shown in Figures 4 to 13. Figure 14 shows the correlation curve of transferrin as determined by PAGE and rock immuno-electrophoresis.

Prealbumin, albumin and transferrin was significantly lower in all groups of patients (Tables 1, 3 and 5), as well as α_2 HS-glycoprotein (Tables 2, 4 and 6). The significant difference among liver diseases for α_2 HS-glycoprotein and albumin is shown in Tables 5 and 6. Hemopexin levels were significantly lower in patients with cholangiocarcinoma when compared with controls (Table 6). There was no significant difference in the Gc-globulin levels in all groups of patients compared with controls (Table 2, 4 and 6).

Acute-phase reactant proteins levels, namely haptoglobin, α_2 -macroglobulin and ceruloplasmin, were significantly increased in all groups of patients in categories 1 and 2 (Tables 2 and 4) except ceruloplasmin levels in patients with amoebic liver abscess (category 2, Table 4). In the third category α_2 -macroglobulin, haptoglobin and ceruloplasmin levels were significantly increased in all diseases except haptoglobin levels in patients with cirrhosis of liver and in patients with carcinoma of the head of the pancreas and ceruloplasmin levels in patients with amoebic liver abscess (Table 5). A significant difference among diseases was noticable (Table 6). The other acute-phase reactant protein level, namely α_1 -acid glycoprotein, was significantly increase only in patients with amoebic liver abscess (Tables 3 and 5).

Table 1: Mean values and standard deviations of prealbumin, albumin, α_1 -acid-glycoprotein and transferrin among controls, other liver diseases and primary liver cell carcinoma by PAGE calculated by analysis of variance.

Parameters	Controls (gr.1)	Other liver Diseases (gr.2)	Primary liver cell carcinoma (gr.3)
Prealbumin (mg/100 ml)	31 ± 10 (19)	13 ± 6 (17)	17 ± 7 (24)
Albumin (g/100 ml)	5.1 ± 0.6 (20)	3.7 ± 0.9 (27)	4.0 ± 0.8 (30)
α_1 -acid glycoprotein (mg/100 ml)	36 ± 14 (20)	44 ± 23 (26)	39 ± 18 (30)
Transferrin (mg/100 ml)	354 ± 53 (20)	189 ± 54 (27)	226 ± 56 (30)

Prealbumin : There are significant differences between "gr.1 & 2" and "gr.1 & 3" ($P < 0.01$); "gr.2 & 3" ($P < 0.05$)

Albumin : There are significant differences between "gr. 1 & 2" and "gr.1 & 3" ($P < 0.01$)

Transferrin: There are significant differences between "gr.1, 2 and gr.3" ($P < 0.01$)



Table 2: Mean values and standard deviations of haptoglobin, α_2 -macroglobulin, ceruloplasmin, α_2 HS-glycoprotein, transferrin, hemopexin and Gc-globulin among controls, other liver diseases and primary liver cell carcinoma by rocket immuno-electrophoresis calculated by analysis of variance.

Parameters (mg/100 ml)	Controls (gr.1)	Other liver Diseases (gr.2)	Primary liver cell carcinoma (gr.3)
Haptoglobin	251 \pm 81 (18)	554 \pm 236 (24)	529 \pm 238 (26)
α_2 -Macroglobulin	168 \pm 32 (20)	267 \pm 93 (25)	264 \pm 72 (28)
Ceruloplasmin	49 \pm 13 (20)	68 \pm 29 (27)	73 \pm 29 (30)
α_2 HS-glycoprotein	73 \pm 15 (19)	38 \pm 13 (27)	60 \pm 18 (27)
Transferrin	311 \pm 44 (20)	163 \pm 57 (27)	281 \pm 76 (30)
Hemopexin	80 \pm 15 (20)	67 \pm 32 (26)	96 \pm 44 (29)
Gc-globulin	34 \pm 5 (20)	31 \pm 8 (27)	34 \pm 10 (29)

- Haptoglobin : There are significant differences between "gr.1 & 2" and "gr.1 & 3" ($P < 0.01$)
- α_2 -Macroglobulin : There are significant differences between "gr.1 & 2" and "gr.1 & 3" ($P < 0.01$)
- Ceruloplasmin : There are significant differences between "gr.1 & 2" and "gr.1 & 3" ($P < 0.01$)
- α_2 -HS glycoprotein : There are significant differences between "gr.1, 2 and gr.3" ($P < 0.01$)
- Transferrin : There are significant differences between "gr.1 & 2" and "gr.2 & 3" ($P < 0.01$)
- Hemopexin : There are significant differences between "gr.2 & 3" ($P < 0.01$)

Table 3: Mean values and standard deviations of prealbumin, albumin, α_1 -acid glycoprotein and transferrin among controls, amebic liver abscess, obstructive jaundice and primary liver cell carcinoma by PAGE calculated by analysis of variance.

Parameters	Controls (gr.1)	Amebic liver abscess (gr.2)	Obstructive jaundice (gr.3)	Primary liver cell carcinoma (gr.4)
Prealbumin (mg/100 ml)	31 \pm 10 (19)	13 \pm 6 (7)	12 \pm 6 (7)	17 \pm 7 (24)
Albumin (g/100 ml)	5.1 \pm 0.6 (20)	3.5 \pm 0.5 (11)	4.1 \pm 1.1 (11)	4.0 \pm 0.8 (30)
α_1 -acid glycoprotein (mg/100 ml)	36 \pm 14 (20)	59 \pm 16 (11)	31 \pm 20 (11)	39 \pm 18 (30)
Transferrin (mg/100 ml)	354 \pm 53 (20)	188 \pm 53 (11)	198 \pm 48 (11)	226 \pm 56 (30)

- Prealbumin : There are significant differences between "gr.1 & 2", "gr.1 & 3" and "gr.1 & 4" ($P < 0.01$); "gr.3 & 4" ($P < 0.05$ - T-test).
- Albumin : There are significant differences between "gr.1 & 2", "gr.1 & 3" and "gr.1 & 4" ($P < 0.01$); "gr.2 & 4" ($P < 0.05$ - T-test).
- α_1 -acid glycoprotein : There are significant differences between "gr.1 & 2", "gr.2 & 3" and "gr.2 & 4" ($P < 0.01$).
- Transferrin : There are significant differences between "gr.1 & 2", "gr.1 & 3", "gr.1 & 4" and "gr.2 & 4" ($P < 0.01$).

Table 4: Mean values and standard deviations of haptoglobin, α_2 -macroglobulin, ceruloplasmin, α_2 HS-glycoprotein, transferrin, hemopexin and Gc-globulin among controls, amebic liver abscess, obstructive jaundice and primary liver cell carcinoma by rocket immuno-electrophoresis calculated by analysis of variance.

Parameters (mg/100 ml)	Controls (gr.1)	Amebic liver abscess (gr.2)	Obstructive jaundice (gr.3)	Primary liver cell carcinoma (gr.4)
Haptoglobin	251 \pm 81 (18)	706 \pm 136 (11)	431 \pm 200 (9)	529 \pm 238 (26)
α_2 -macroglobulin	168 \pm 32 (20)	253 \pm 105 (10)	243 \pm 41 (11)	264 \pm 72 (28)
Ceruloplasmin	49 \pm 13 (20)	54 \pm 26 (11)	81 \pm 25 (11)	73 \pm 29 (30)
α_2 HS-glycoprotein	73 \pm 15 (19)	33 \pm 7 (11)	41 \pm 12 (11)	60 \pm 18 (27)

Table 4 (Continued)

Parameters (mg/100 ml)	Controls (gr.1)	Amebic liver abscess (gr.2)	Obstructive jaundice (gr.3)	Primary liver cell carcinoma (gr.4)
Transferrin	311 \pm 44 (20)	154 \pm 63 (11)	159 \pm 37 (11)	281 \pm 76 (30)
Hemopexin	80 \pm 15 (20)	89 \pm 29 (11)	47 \pm 24 (11)	96 \pm 44 (29)
Gc-globulin	34 \pm 5 (20)	33 \pm 9 (11)	30 \pm 4 (11)	34 \pm 10 (29)

Haptoglobin : There are significant differences between "gr.1 & 2", "gr.1 & 3", "gr.1 & 4", "gr.2 & 3" and "gr.2 & 4" ($P < 0.01$).

α_2 -Macroglobulin : There are significant differences between "gr.1 & 2", "gr.1 & 3", and "gr.1 & 4" ($P < 0.01$).

Ceruloplasmin : There are significant differences between "gr.1 & 3", "gr.1 & 4" and "gr.2 & 3" ($P < 0.01$) and "gr.2 & 4" ($P < 0.05$).

- α_2 -HS glycoprotein : There are significant differences between "gr.1 & 2", "gr.1 & 3", "gr.1 & 4", "gr.2 & 4" and "gr.3 & 4" ($P < 0.01$) and "gr.2 & 3" ($P < 0.05$ - T-test).
- Transferrin : There are significant differences between "gr.1 & 2", "gr.1 & 3", "gr.2 & 4" and "gr.3 & 4" ($P < 0.01$)
- Hemopexin : There are significant differences between "gr.1 & 3", "gr.2 & 3" and "gr.3 & 4" ($P < 0.01$).

Table 5: Mean values and standard deviations of prealbumin, albumin, α_1 -acid glycoprotein, and transferrin among controls, amebic liver abscess, cirrhosis, cholangiocarcinoma, carcinoma of the head of pancreas and primary liver cell carcinoma by PAGE calculated by analysis of variance.

Parameters	Controls (gr.1)	Amebic liver abscess (gr.2)	Cirrhosis (gr.3)	Cholangio- carcinoma (gr.4)	Carcinoma head of pancreas (gr.5)	Primary liver cell carcinoma (gr.6)
Prealbumin (mg/100 ml)	31 ± 10 (19)	13 ± 6 (7)	15 ± 9 (3)	11 ± 7 (4)	14 ± 5 (3)	17 ± 7 (24)
Albumin (g/100 ml)	5.1 ± 0.6 (20)	3.5 ± 0.5 (11)	3.2 ± 1.1 (5)	4.1 ± 0.8 (7)	4.1 ± 1.6 (4)	4.0 ± 0.8 (30)
α_1 -acid glyco- protein (mg/100 ml)	36 ± 14 (20)	59 ± 16 (11)	37 ± 25 (4)	32 ± 19 (7)	29 ± 25 (4)	39 ± 18 (30)
Transferrin (mg/100 ml)	354 ± 53 (20)	188 ± 53 (11)	171 ± 75 (5)	180 ± 25 (7)	229 ± 67 (4)	226 ± 56 (30)

- Prealbumin : There are significant differences between "gr.1 & 2", "gr.1 & 3", "gr.1 & 4", "gr.1 & 5" and "gr.1 & 6" ($P < 0.01$).
- Albumin : Three are significant differences between "gr.1 & 2", "gr.1 & 3", "gr.1 & 4" and "gr.1 & 6" ($P < 0.01$); "gr.1 & 5" and "gr.3 & 6" ($P < 0.05$); "gr.2 & 4" and "gr.2 & 6" ($P < 0.05$ -T-test).
- α_1 -acid glycoprotein : There are significant differences between "gr.1 & 2", "gr.2 & 4", "gr.2 & 5" and "gr.2 & 6" ($P < 0.01$); "gr.2 & 3" ($P < 0.05$).
- Transferrin : There are significant differences between "gr.1 & 2", "gr.1 & 3", "gr.1 & 4", "gr.1 & 5" "gr.1 & 6", "gr.2 & 6", "gr.3 & 6" and "gr.4 & 6" ($P < 0.01$).

Table 6: Mean values and standard deviations of haptoglobin, α_2 -macroglobulin, ceruloplasmin, α_2 HS-glycoprotein, transferrin, hemopexin and Gc-globulin among controls, amebic liver abscess, cirrhosis, cholangiocarcinoma, carcinoma of the head of pancreas and primary liver cell carcinoma by rocket immunoelectrophoresis calculated by analysis of variance.

Parameters (mg/100 ml)	Controls (gr.1)	Amebic liver abscess (gr.2)	Cirrhosis (gr.3)	Cholangio- carcinoma (gr.4)	Carcinoma head of pancreas (gr.5)	Primary liver cell carcinoma (gr.6)
Haptoglobin	251 \pm 81 (18)	706 \pm 136 (11)	355 \pm 276 (4)	418 \pm 229 (6)	458 \pm 164 (3)	529 \pm 238 (26)
α_2 -Macroglobulin	168 \pm 32 (20)	253 \pm 105 (10)	363 \pm 122 (4)	245 \pm 27 (7)	240 \pm 65 (4)	264 \pm 72 (28)
Ceruloplasmin	49 \pm 13 (20)	54 \pm 26 (11)	69 \pm 33 (5)	84 \pm 27 (7)	74 \pm 26 (4)	73 \pm 29 (30)
α_2 HS-glyco- protein	73 \pm 15 (19)	33 \pm 7 (11)	40 \pm 22 (5)	39 \pm 12 (7)	46 \pm 11 (4)	60 \pm 18 (27)

Table 6 (Continued)

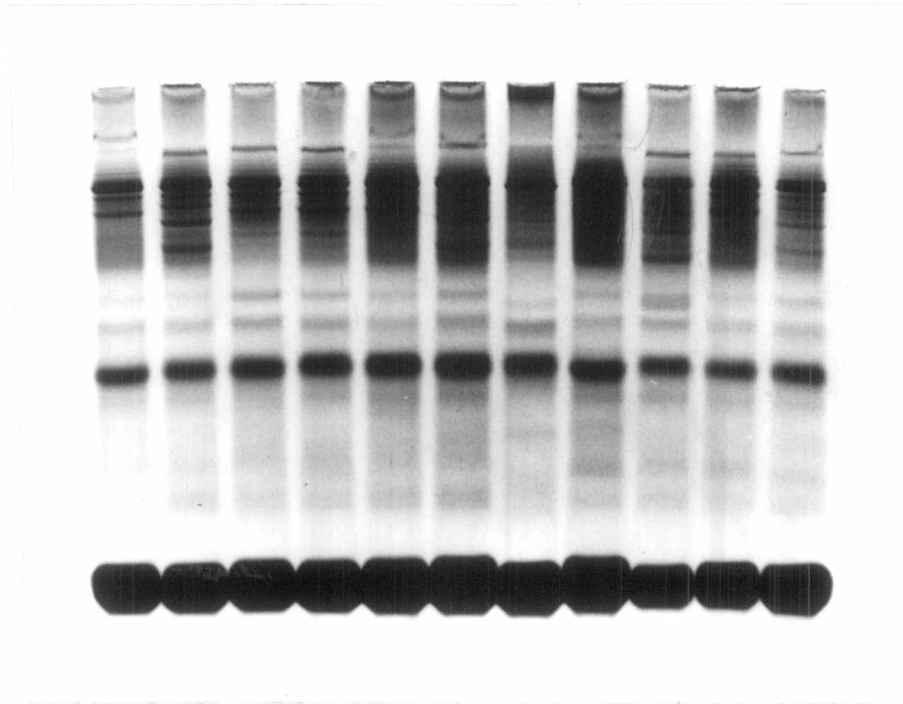
Parameters (mg/100 ml)	Controls (gr.1)	Amebic liver abscess (gr.2)	Cirrhosis (gr.3)	Cholangio- carcinoma (gr.4)	Carcinoma head of pancreas (gr.5)	Primary liver cell carcinoma (gr.6)
Transferrin	311 \pm 44 (20)	154 \pm 63 (11)	191 \pm 80 (5)	157 \pm 33 (7)	162 \pm 48 (4)	281 \pm 76 (30)
Hemopexin	80 \pm 15 (20)	89 \pm 29 (11)	59 \pm 26 (4)	42 \pm 22 (7)	56 \pm 28 (4)	96 \pm 44 (29)
Gc-globulin	34 \pm 5 (20)	33 \pm 9 (11)	30 \pm 13 (5)	31 \pm 4 (7)	30 \pm 4 (4)	34 \pm 1 (29)

- Haptoglobin : There are significant differences between "gr.1 & 2", "gr.1 & 6", "gr.2 & 3", "gr.2 & 4" and "gr.2 & 6" ($P < 0.01$); "gr.1 & 4" and "gr.2 & 5" ($P < 0.05$)
- α_2 -Macroglobulin : There are significant differences between "gr.1 & 2", "gr.1 & 3", "gr.1 & 4", "gr.1 & 6", "gr.2 & 3", "gr.3 & 4" and "gr.3 & 6" ($P < 0.01$); "gr.1 & 5" and "gr.3 & 5" ($P < 0.05$)

- Ceruloplasmin : There are significant differences between "gr.1 & 4" and "gr.1 & 6" ($P < 0.01$); "gr.2 & 4" and "gr.2 & 6" ($P < 0.05$); "gr.1 & 3" ($P < 0.025$ - T-test) and "gr.1 & 5" ($P < 0.005$ - T-test).
- α_2 -HS glycoprotein : There are significant differences between "gr.1 & 2", "gr.1 & 3", "gr.1 & 4", "gr.1 & 5", "gr.1 & 6", "gr.2 & 6", "gr.3 & 6" and "gr.4 & 6" ($P < 0.01$); "gr.2 & 5" ($P < 0.01$ - T-test).
- Transferrin : There are significant differences between "gr.1 & 2", "gr.1 & 3", "gr.1 & 4", "gr.1 & 5", "gr.2 & 6", "gr.3 & 6", "gr.4 & 6" and "gr.5 & 6" ($P < 0.01$).
- Hemopexin : There are significant differences between "gr.1 & 4", "gr.2 & 4" and "gr.4 & 6" ($P < 0.01$); "gr.3 & 6" and "gr.5 & 6" ($P < 0.05$); "gr.2 & 3" and "gr.2 & 5" ($P < 0.05$ -T-test).



①



⊕

Figure 1: Bands of serum proteins produced by PAGE.

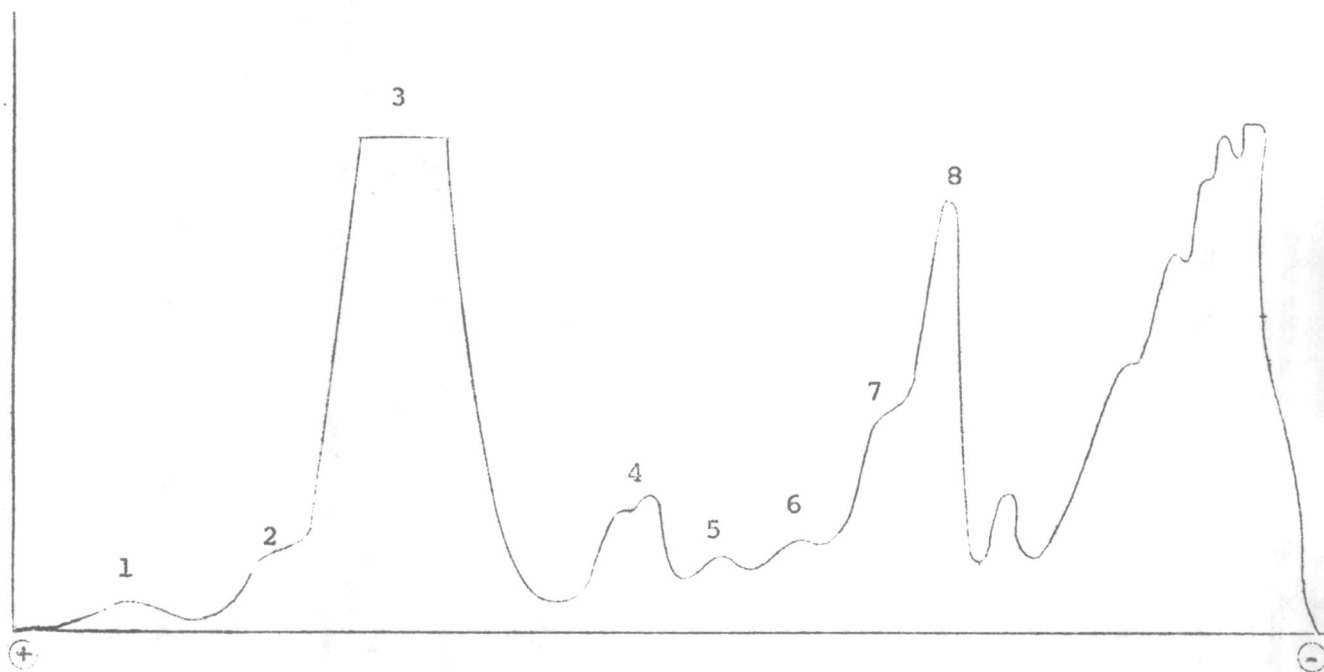


Figure 2: Electropherogram obtained from PAGE

1. Prealbumin
2. α_1 -acid-glycoprotein
3. Albumin
4. Gc-globulin, α_1 -antichymotrypsin and α_1 -B₁-glycoprotein
5. α_2 HS-glycoprotein
6. Hemopexin
7. Ceruloplatin
8. Transferrin

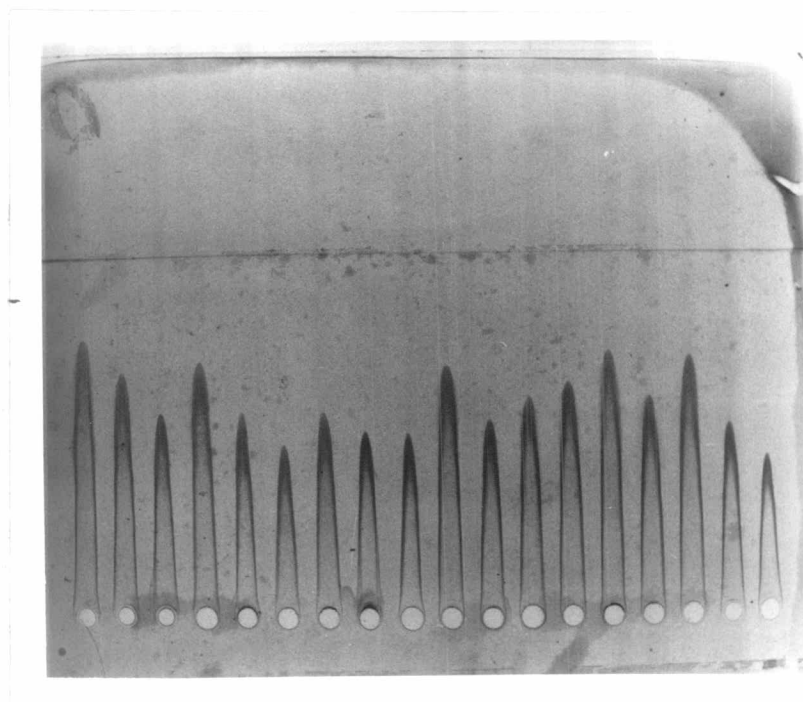


Figure 3: Peaks of transferrin produced by rocket immunoelectrophoresis.

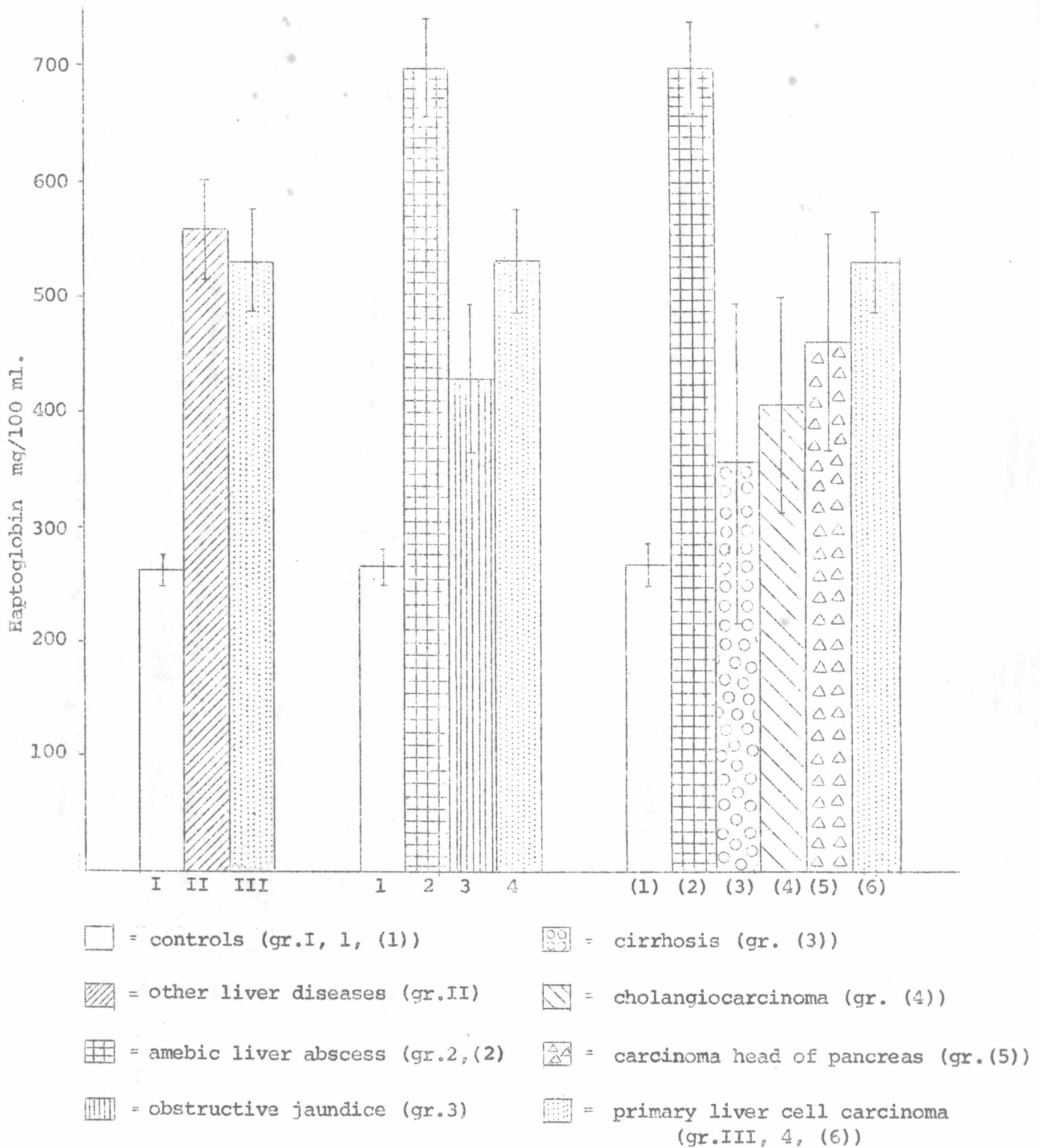
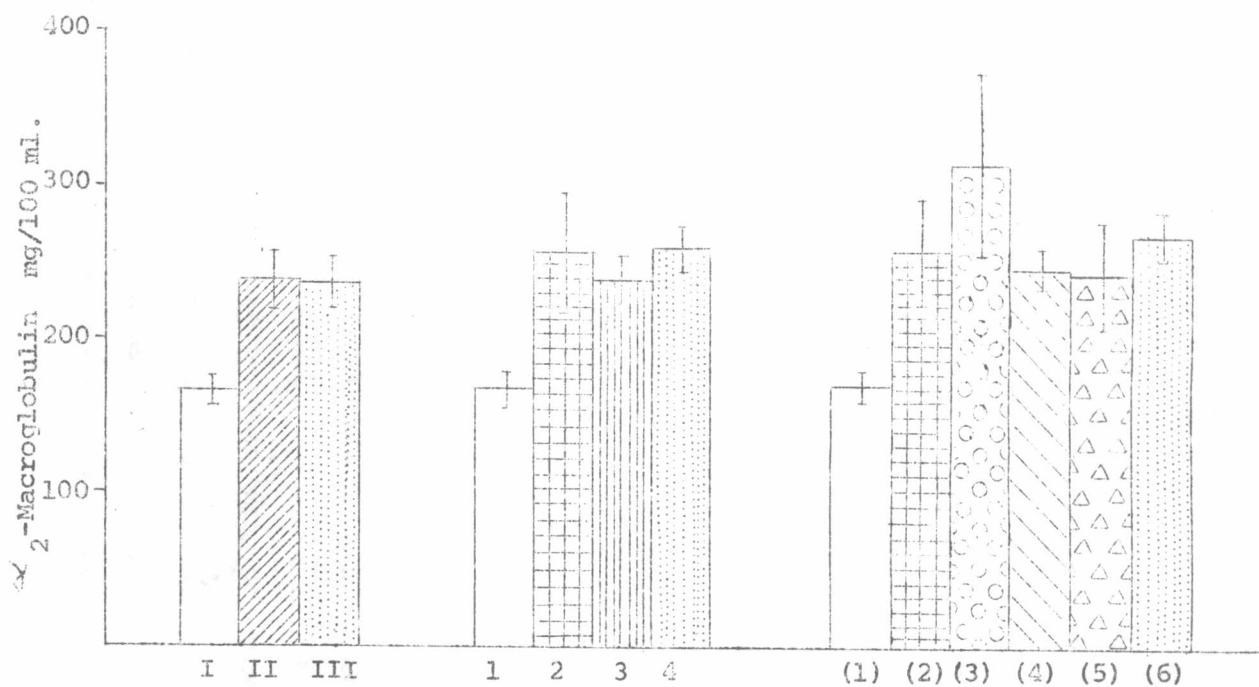


Figure 4: Mean values and standard errors for haptoglobin in controls and liver diseases.



- = controls (gr.I, 1, (1))
- ▨ = other liver diseases (gr.II)
- ▧ = amebic liver abscess (gr.2, (2))
- ▩ = obstructive jaundice (gr.3)
- = cirrhosis (gr. (3))
- = cholangiocarcinoma (gr. (4))
- ▬ = carcinoma head of pancreas (gr. (5))
- ▭ = primary liver cell carcinoma (gr.III, 4, (6))

Figure 5: Mean values and standard errors for α_2 -macroglobulin in controls and liver diseases.

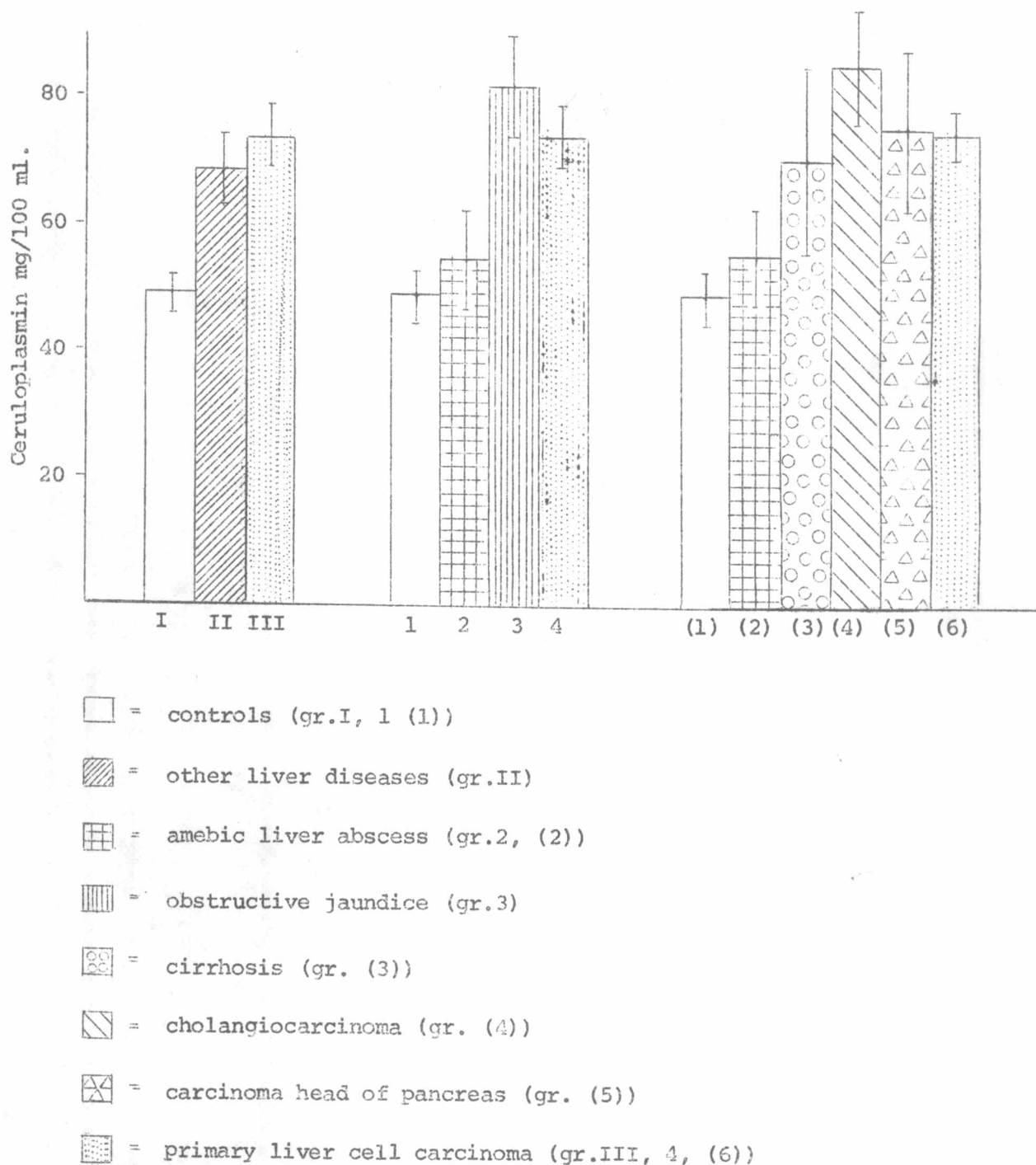
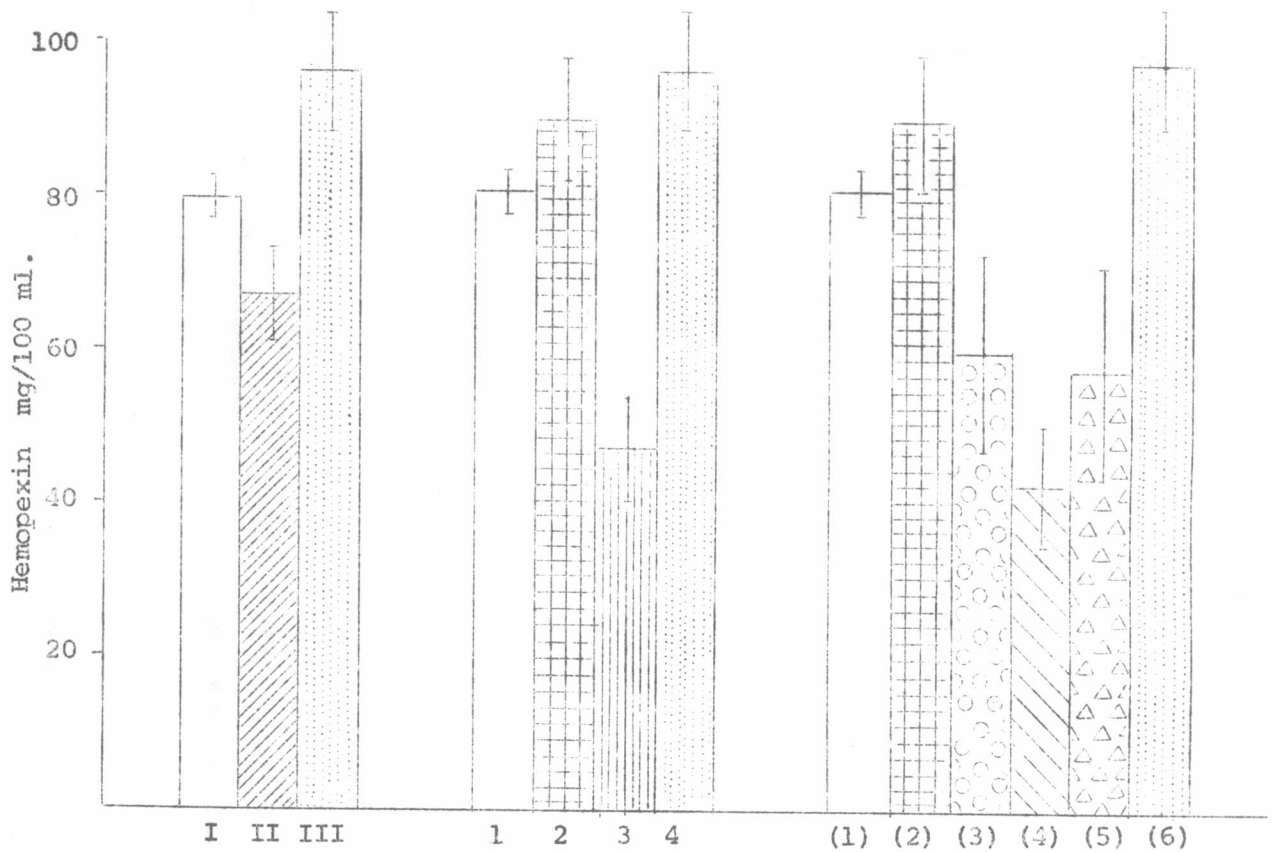
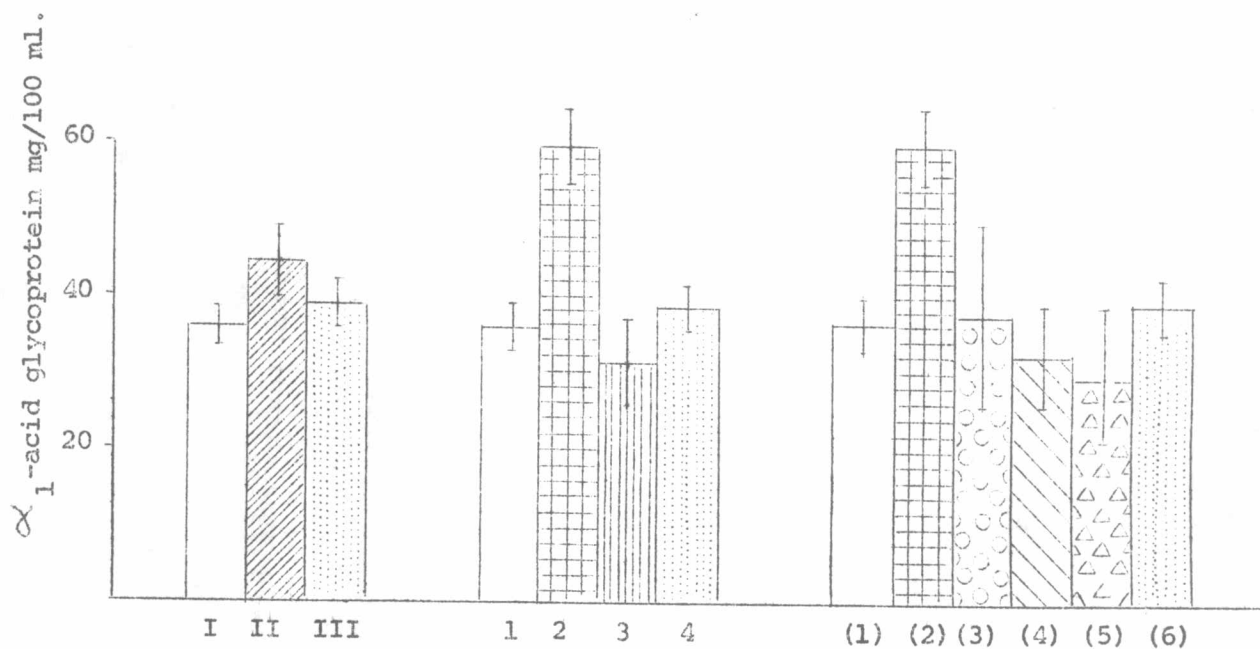


Figure 6: Mean values and standard errors for ceruloplasmin in controls and liver diseases.



- = controls (gr.I, 1, (1))
- ▨ = other liver diseases (gr. II)
- ▧ = amebic liver abscess (gr.2, (2))
- ▩ = obstructive jaundice (gr. 3)
- ⊗ = cirrhosis (gr. (3))
- ▤ = cholangiocarcinoma (gr. (4))
- ⊠ = carcinoma head of pancreas (gr. (5))
- ▣ = primary liver cell carcinoma (gr.III, 4, (6))

Figure 7: Mean values and standard errors for hemopexin in controls and liver diseases.











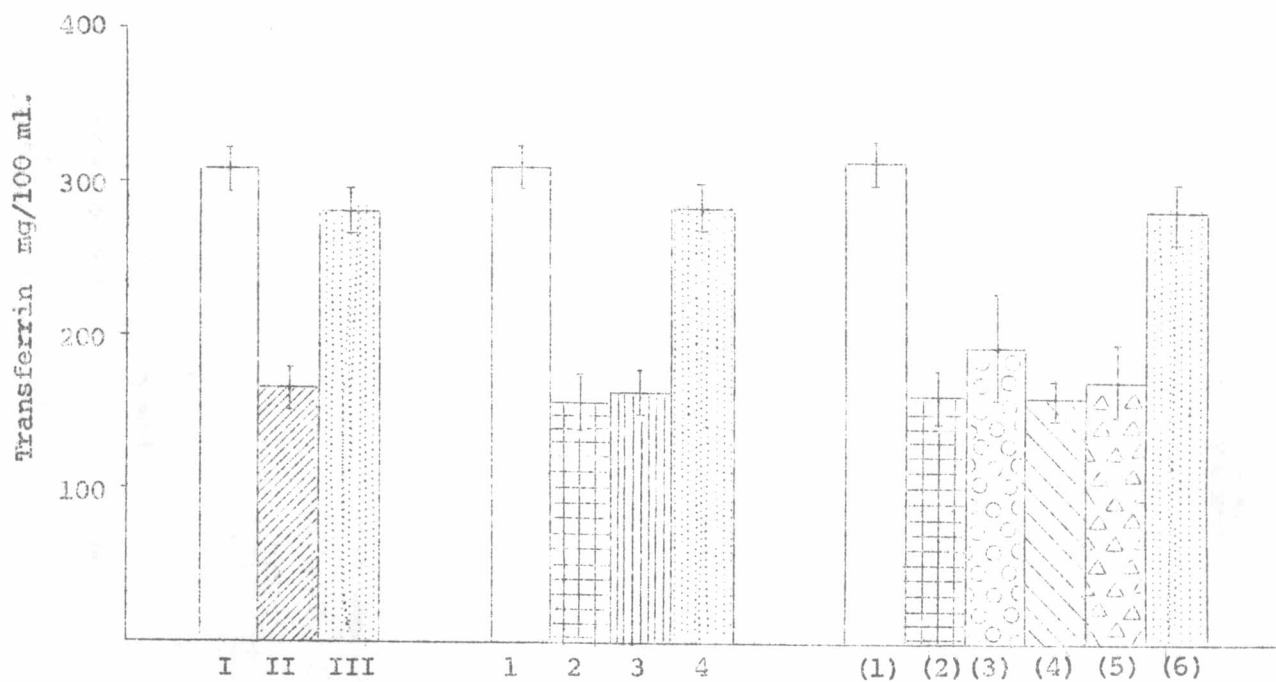
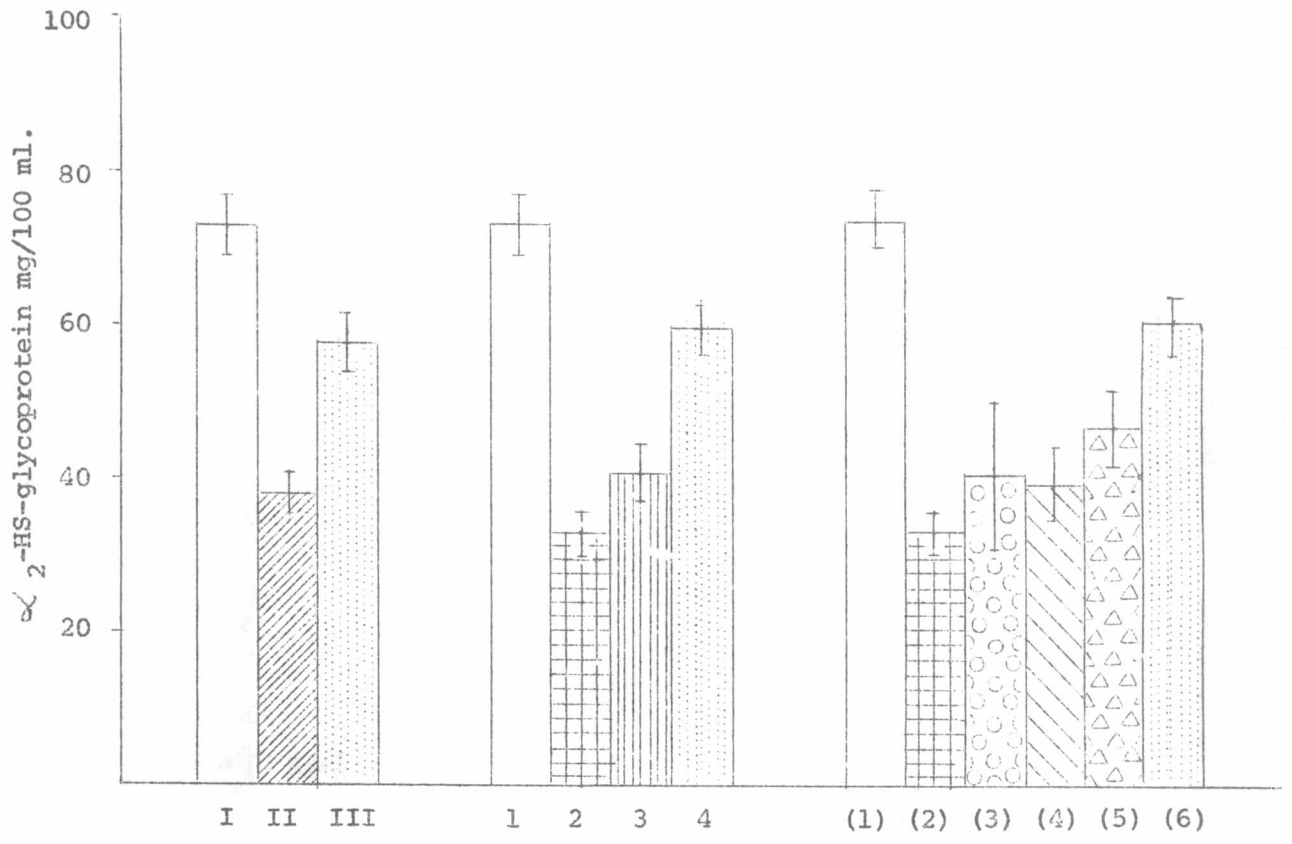
-  = controls (gr.I, 1, (1))
-  = other liver diseases (gr.II)
-  = amebic liver abscess (gr.2, (2))
-  = obstructive jaundice (gr.3)
-  = cirrhosis (gr. (3))
-  = cholangiocarcinoma (gr. (4))
-  = carcinoma head of pancreas (gr.(5))
-  = primary liver cell carcinoma (gr.III, 4, (6))

Figure 8: Mean values and standard errors for α_1 -acid glycoprotein in controls and liver diseases.



- = controls (gr.I, 1, {1})
- ▨ = other liver diseases (gr. II)
- ▧ = amebic liver abscess (gr.2, {2})
- ▩ = obstructive jaundice (gr.3)
- = cirrhosis (gr. (3))
- = cholangiocarcinoma (gr. (4))
- ▬ = carcinoma head of pancreas (gr. (5))
- ▭ = primary liver cell carcinoma (gr.III, 4, {6})

Figure 9: Mean values and standard errors for transferrin in controls and liver diseases.



- = controls (gr.I, 1, (1))
- ▨ = other liver diseases (gr.II)
- ▩ = amebic liver abscess (gr.2, (2))
- ▧ = obstructive jaundice (gr.3)
- ⊞ = cirrhosis (gr. (3))
- ▤ = cholangiocarcinoma (gr. (4))
- ⊠ = carcinoma head of pancreas (gr. (5))
- ▣ = primary liver cell carcinoma (gr.III, 4, (6))

Figure 10: Mean values and standard errors for α_2 HS-glycoprotein in controls and liver diseases.

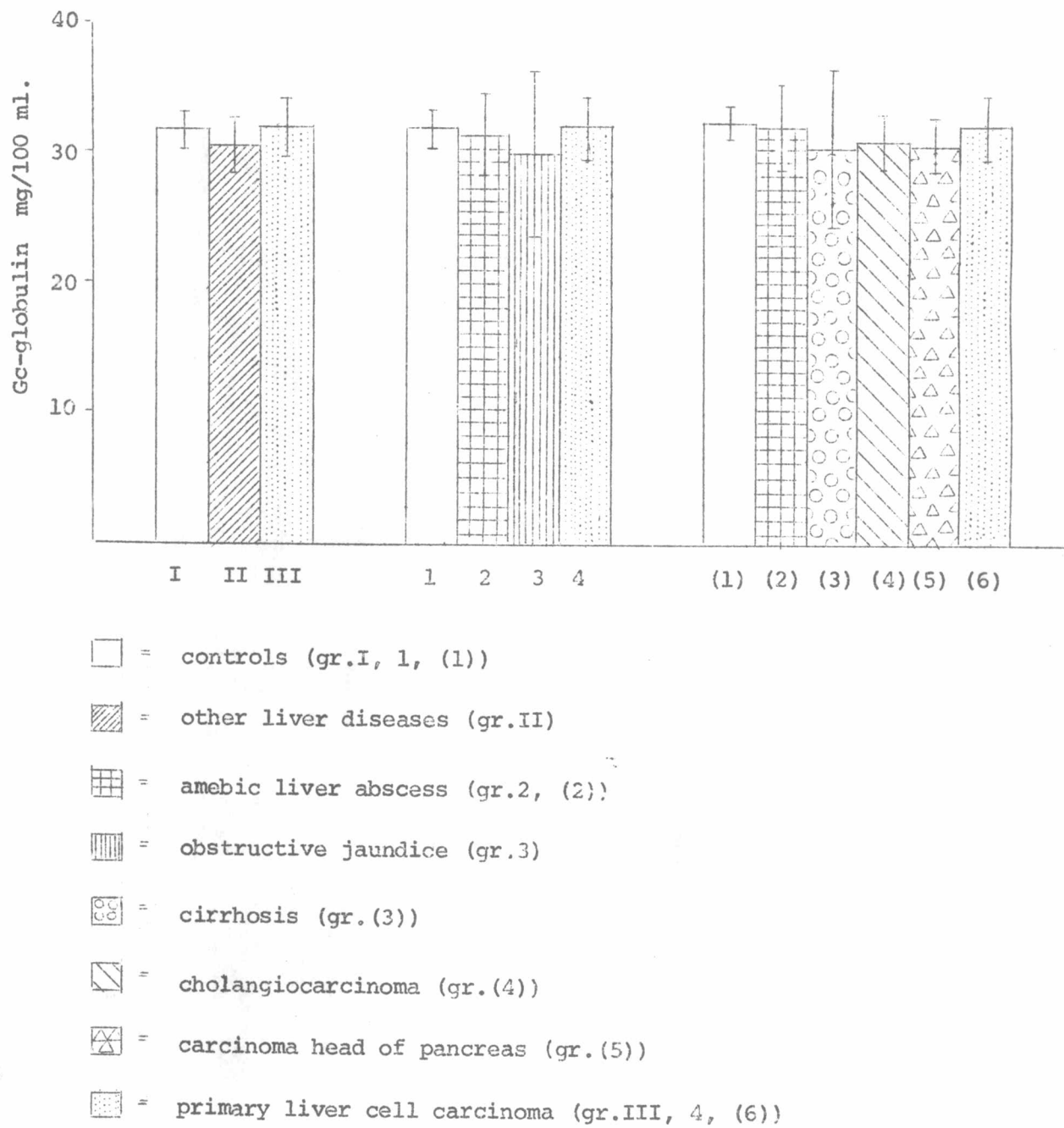
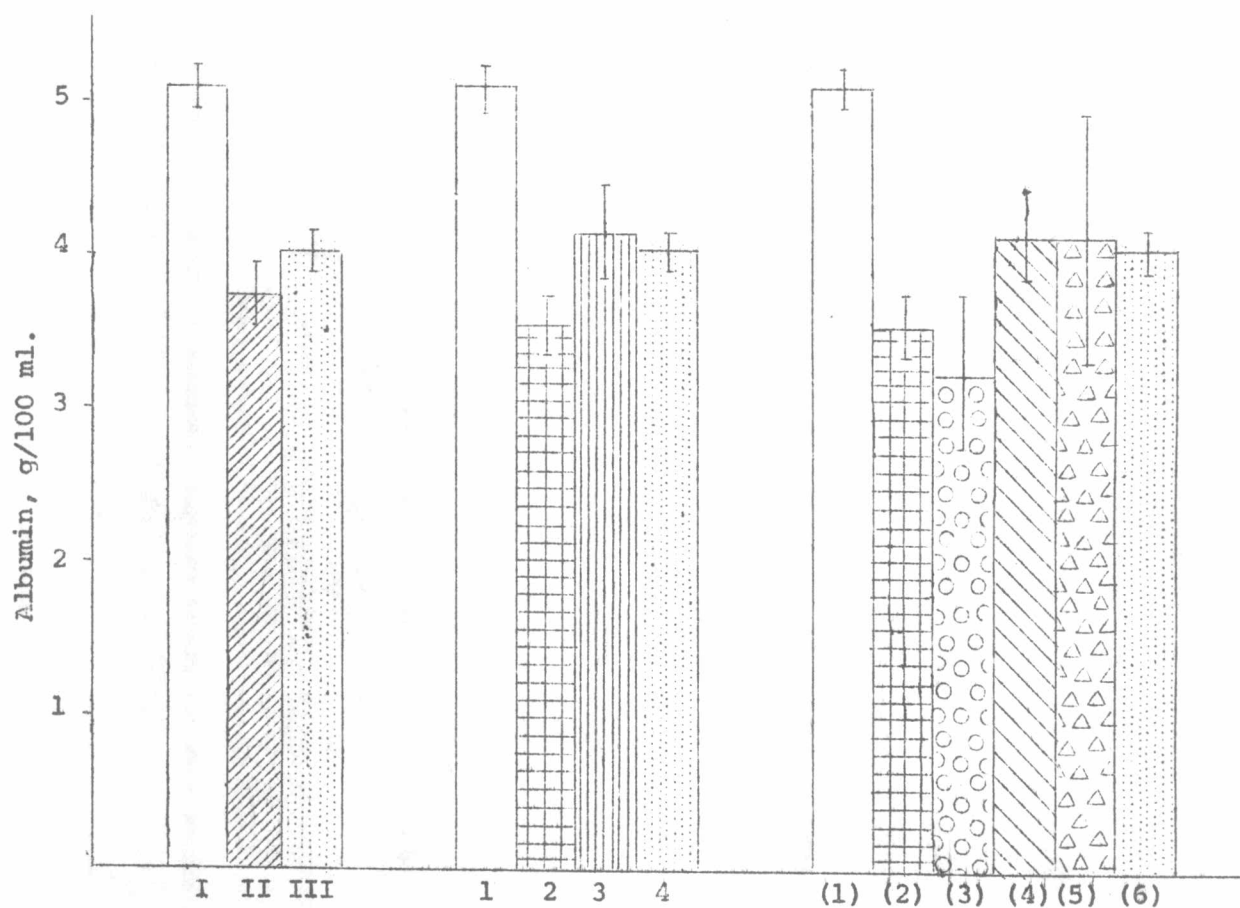


Figure 11: Mean values and standard errors for Gc-globulin in controls and liver diseases.



- = controls (gr.I, 1, (1))
- ▨ = other liver diseases (gr.II)
- ▧ = amebic liver abscess (gr.2, (2))
- ▩ = obstructive jaundice (gr.3)
- ⊙ = cirrhosis (gr.(3))
- ▤ = cholangiocarcinoma (gr.(4))
- ⊠ = carcinoma head of pancreas (gr.(5))
- ▦ = primary liver cell carcinoma (gr.III, 4, (6))

Figure 12: Mean values and standard errors for albumin in controls and liver diseases.

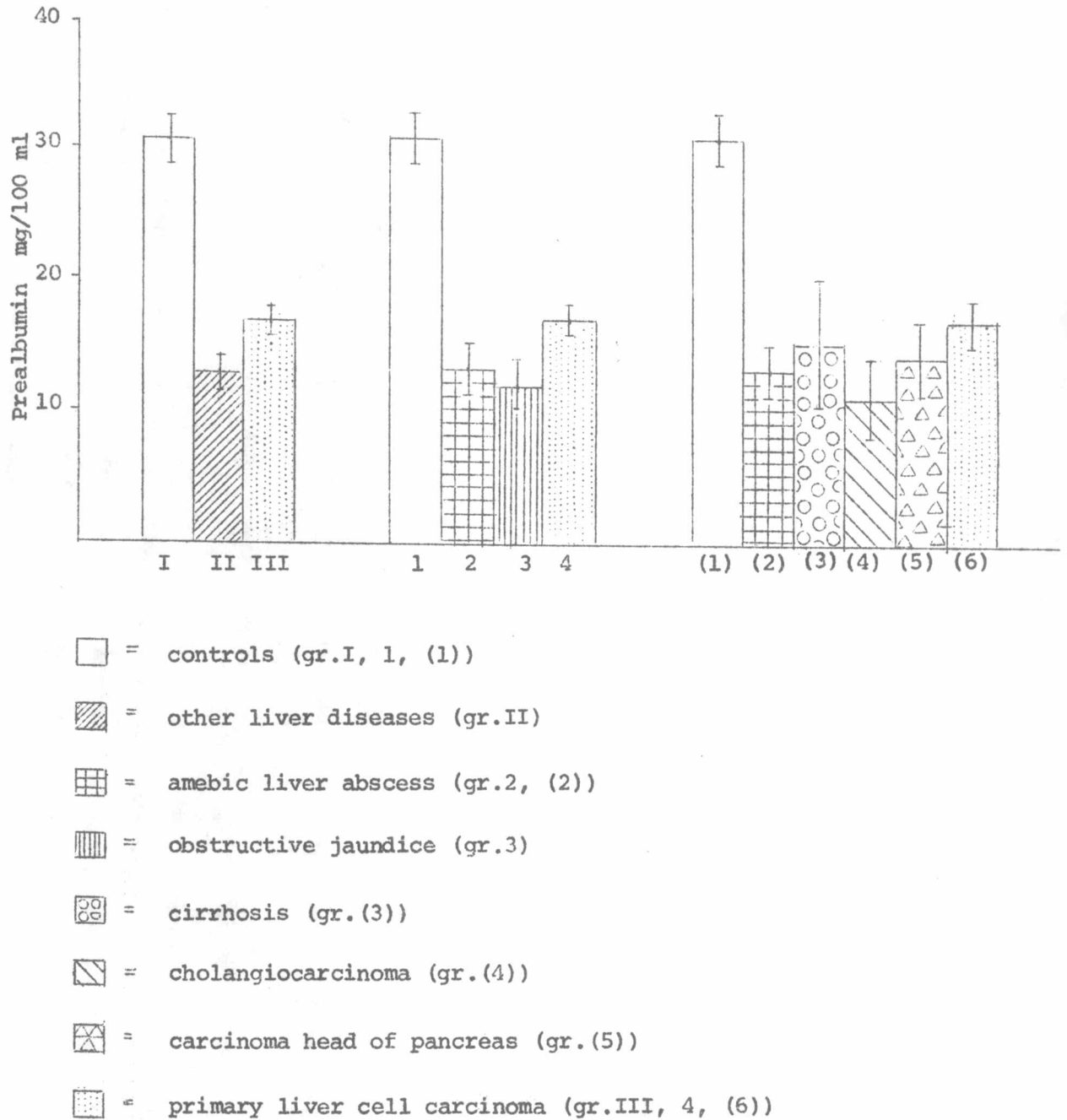


Figure 13: Mean values and standard errors for prealbumin in controls and liver diseases.

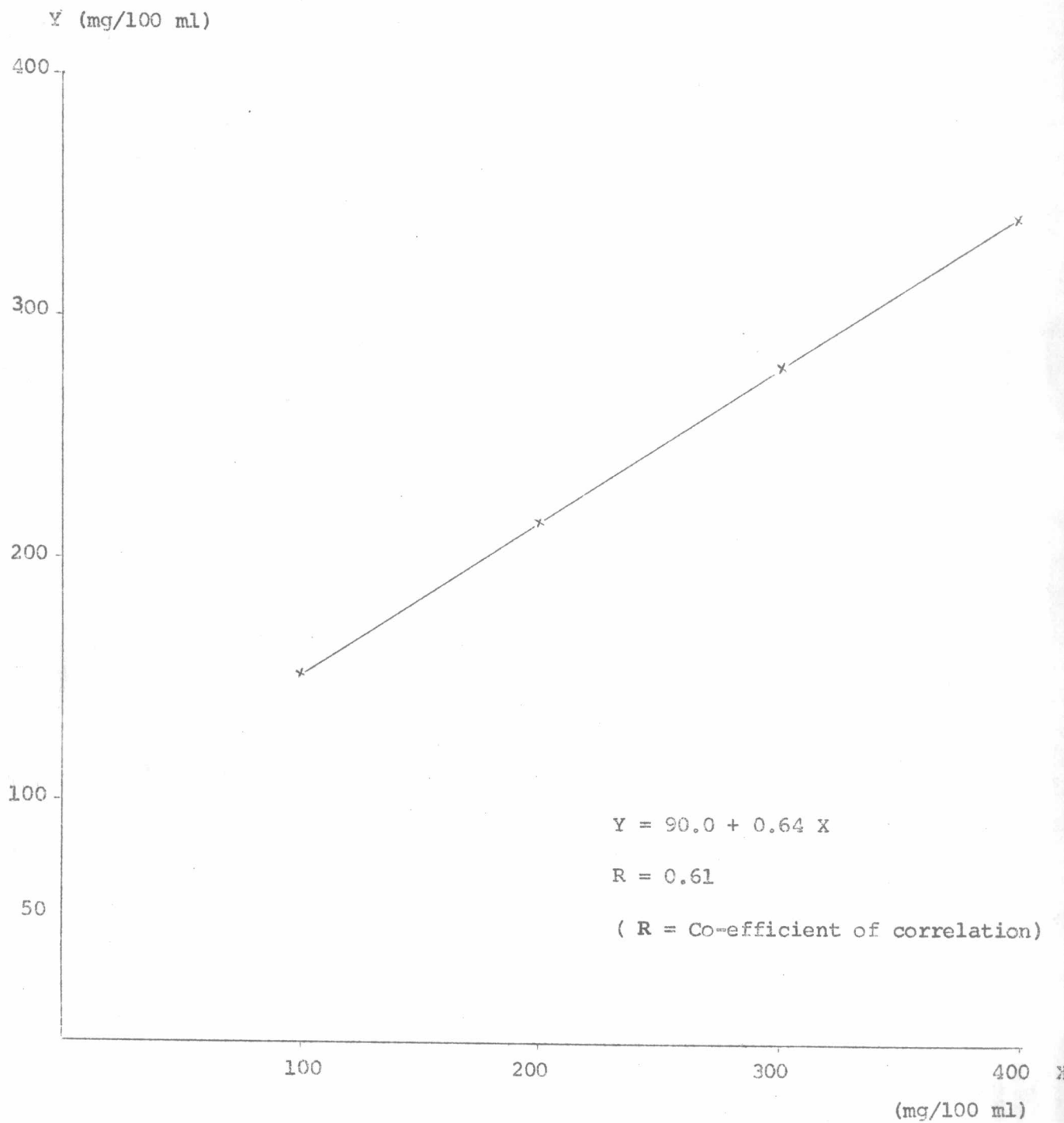


Figure 14: Correlation between transferrin by PAGE and rocket-immunoelectrophoresis in controls, primary liver cell carcinoma and other liver diseases.