Assessment of effects of propranolol on portal hemodynamics in cirrhosis by duplex ultrasonography

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Objective: To study the effect of propranolol on portal hemodynamics in cirrhosis using duplex ultrasonography. Methods: Portal venous flow was measured by duplex ultrasonography in 12 healthy volunteers and ten men with cirrhosis. The cirrhotics were evaluated prior to and after ingestion of propranolol (60 mg twice daily for seven days) or placebo in a randomized cross-over fashion. Variations in heart rate, blood pressure, portal vein diameter, and portal venous flow and velocity were evaluated. Results: The mean (SD) portal venous flow in the volunteers was 745 (280) ml/min, portal flow velocity was 18.5 (3.6) cm/s and portal vein diameter was 9.2 (1.4) mm. In cirrhotics, propranolol decreased portal blood flow from 586 (220) to 413 (120) ml/min (p<0.03), the overall reduction being 29.5%. This effect was due to decrease in portal flow velocity, from 12.5 (3.3) to 9.7 (2.3) cm/s (p<0.03) without significant change in portal vein diameter. No changes were observed with placebo. Conclusions: Propranolol decreases portal flow velocity and thus portal venous flow in cirrhotics. [Indian J Gastroenterol 1998; 17: 51-52]

Key words: Doppler flowmetry, portal hypertension

Duplex ultrasonography is a noninvasive method for evaluation of portal hemodynamics. It has been used to evaluate the effects of physiologic and pharmacologic stimuli in portal hypertensive patients. We evaluated the portal venous flow in healthy subjects and patients with cirrhosis, and studied the effect of propranolol on portal flow in the latter using this technique.

Methods

Ten men with liver cirrhosis (median age 41 years, range 27-66) and 12 healthy male volunteers (median age 31 years, range 23-41) were studied. The diagnosis of cirrhosis was established by biopsy in 5 patients and by clinical and investigative data including ultrasonography and endoscopic demonstration of esophageal varices in the remaining. The etiology was alcohol in 6 patients and hepatitic in 4. Three patients had ascites and five had history of variceal bleed. No patient had bled within the last four weeks, nor was any on drugs that could alter portal hemodynamics. All patients gave informed consent; the study was approved by the hospital ethics committee.

Echo-doppler flowmetry was performed using a duplex pulsed-wave doppler (RT-350; GE) that combines a sector scanner (B mode) of 3.5 MHz and a pulsed-doppler device with a pulse repetition frequency of 2.0 KHz and a wall filter of 100 Hz. The study was performed in all cases by the same examiner who was unaware of the case details. The subjects were fasted and all measurements were taken during quiet suspended inspiration. Using an intercostal approach the portal vein was first imaged along its longitudinal axis using the B mode. Portal vein diameter was measured at a location 1-2 cm proximal to its bifurcation, assuming that at this site the elliptic shape of the portal vein converges towards a circle. Doppler signals were obtained using a 3.0 mm sample volume cursor located at the center of the portal vein at a known angle of insonation (angle between doppler beam and the long axis of the vessel). Care was taken to maintain the angle below 60°, since accuracy of measurements decreases with greater angle. For measuring the portal flow velocity (PFV), the flow velocity integral over a given time was measured directly by the dedicated software and from it the mean portal flow velocity per second was calculated. The portal blood flow (mL/min) was obtained as PFV x A x 60, where A is the cross-sectional area of the portal vein, measured as πd²/4, d being the inner diameter of the portal vein.

Each measurement was repeated until reproducible spectrum patterns and blood-flow sounds were obtained. Caliber of portal vein, mean velocity and portal blood flow were measured in triplicate and mean values taken. Baseline portal flow was also estimated in the volunteers.

After baseline readings, each patient was studied with propranolol 60 mg twice daily and placebo in a randomized cross-over fashion. The drugs were administered for seven days each with a wash-out period of two weeks.

Statistical analysis was performed using Student’s t test, coefficient of correlation and one-way analysis of variance. Results are expressed as mean (SD).

Results

No differences were noted in portal vein diameter between the volunteers and cirrhotics (9.2 (1.4) vs 9.9 (1.5) mm; p/ns). Portal flow velocity was decreased in the cirrhotics (12.5 (3.3) vs 18.5 (3.5) cm/s²; p<0.04). Although the mean portal venous flow was less in cirrhotics (586 (22) vs 746 (280) ml/min), the difference was not significant.

Propranolol caused a reduction in heart rate (p<0.04) and systolic blood pressure (p<0.02), but not in diastolic blood pressure (Table). All but one patient showed reduc-
Table: Hemodynamic data in cirrhotic patients with propranolol or placebo therapy (n=18)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Propranolol</th>
<th>Placebo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart rate (per min)</td>
<td>87.2 (14.4)</td>
<td>70.2 (15.6)</td>
</tr>
<tr>
<td>Systolic BP (mmHg)</td>
<td>113.4 (25.2)</td>
<td>106.0 (27.3)</td>
</tr>
<tr>
<td>Systolic BP (mmHg)</td>
<td>113.4 (25.2)</td>
<td>106.0 (27.3)</td>
</tr>
<tr>
<td>Diastolic BP (mmHg)</td>
<td>72.2 (7.0)</td>
<td>70.8 (8.9)</td>
</tr>
<tr>
<td>Portal flow velocity (cm/s)</td>
<td>12.5 (3.3)</td>
<td>9.7 (3.3)</td>
</tr>
<tr>
<td>Portal vein diameter (mm)</td>
<td>9.9 (1.5)</td>
<td>9.5 (1.2)</td>
</tr>
<tr>
<td>Portal venous flow (mL/min)</td>
<td>585 (220)</td>
<td>413 (120)</td>
</tr>
</tbody>
</table>

Values as mean (SD). p <0.001, <0.03, <0.02 compared to pre-treatment value.

...tion in portal venous flow (overall 29.5%). This was mainly
due to reduction in portal flow velocity without change in
portal vein caliber. There was no correlation between the
decrease in heart rate following propranolol and decrease
in portal flow velocity and portal venous flow. Placebo
had no effect on any of the parameters studied (Table).

There was no significant variation between the portal
flow values obtained at baseline, after washout and after
placebo therapy, on one-way analysis of variance.

Discussion

Most studies show normal or reduced portal flow in
cirrhosis, but some have demonstrated increased flow.12
Much of this variation may be due to differences in stages
of portal hypertension. Portal congestion may cause a
decrease in portal flow velocity. Kawasaki et al8 postu-
lated that hypodynamic portal perfusion occurs due to
development of extrahepatic shunts, while hyperdynamic
perfusion occurs due to development of prominent intra-
hepatic shunts. We found the blood flow in the main portal
vein less in cirrhotics, though not significantly. The
decrease was mainly due to lower portal flow velocity.

Propranolol has been shown to decrease portal pres-
sure13 and the rate of recurrent gastrointestinal bleeding.14
Usually its dose is titrated until the heart rate drops by
25% or to 55 beats/min or less.15 We could not find any
correlation between drop in heart rate and reduction in
portal venous flow. Propranolol 60 mg twice daily for 7
days caused a decrease in portal flow in cirrhotics, mainly
due to decrease in portal flow velocity. Recent studies in
cirrhotics have shown that propranolol 40 mg causes a
reduction in portal venous flow and flow velocity.16,17

In conclusion, duplex ultrasonography is useful in
evaluating the effects of a drug on portal hemodynamics.
It may help to identify patients with cirrhosis who may
benefit from propranolol therapy.

References


Dr Chawla, Additional Professor and Head. Fax: (172) 84 0801 Received August 6, 1987. Received in final revised form October 23, 1987. Accepted November 10, 1987

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