Investigation of the portal perfusion index after low diameter mesocaval interposition and distal splenorenal shunt – a prospective study

K.-J. Paquet1, M. A. Mercado1, H. Klingele2, and R. Klingele2

1 Department für Chirurgie und Gefäßchirurgie, Heinz-Kalk-Krankenhaus, W-8730 Bad Kissingen, Federal Republic of Germany
2 Institut für Nuklearmedizin und Strahlenheilkunde, Leopoldinakrankenhaus der Stadt Schweinfurt, W-8720 Schweinfurt, Federal Republic of Germany

Summary. In 50 consecutive patients portal blood flow was determined using computed liver perfusion scintigraphy preoperatively and at 6, 12, 24, 36, 48, 60, 72, and 84 months postoperatively between 1 January 1983 and 1 January 1990. All 25 subjects had undergone placement of a distal splenorenal shunt (DSRS) and 25, insertion of low-diameter PTFE mesocaval interposition shunt (LDMIS) between 15 January 1983 and 1 January 1988. Indications for shunt operation included recurrent variceal hemorrhage in spite of long-term endoscopic sclerotherapy, a Child-Pugh classification of A or B, a sonographically determined liver volume of between 1000 and 2500 ml, exclusion of the activity and progression of liver disease by biopsy and stenosis of the hepatic artery or coeliac trunk. DSRS was performed when the portal perfusion index (PPI) was >30% (normal values 56 ± 5%) and LDMIS was carried out when the PPI was 10% to 30%. In all cases the underlying disease was liver cirrhosis of alcoholic (n = 34, 68%) or hepatic (n = 12, 24%) etiology. Five patients who underwent LDMIS had originally scheduled for DSRS at a PPI of >30%; because the DSRS would have been technically difficult due to severe chronic pancreatitis, a LDMIS was performed. One in-hospital death due to liver failure had occurred in each group by 1 January 1990. One patient in the DSRS group and two in the LDMIS group died later, and in each group one patient was lost to follow-up. In the DSRS group, no case of encephalopathy or rebleeding was encountered, and in the LDMIS group, one case each of encephalopathy (4%) and rebleeding (4%) were recorded. In the DSRS group, the PPI value showed a steady reduction from 38% (preoperatively) to 15% (after 7 years); the same tendency could be demonstrated in the LDMIS group from 24% to 0). The difference between the preoperative and late postoperative PPI values obtained for both shunt types was statistically significant. We concluded that a reduction in portal blood flow to the liver develops during the period following the surgical implantation of a selective or non-selective shunt. LDMIS maintains portal perfusion for at least 6 years post-surgery. Thus, LDMIS constitutes an excellent alternative in patients in whom the insertion of a Warren shunt is either not possible or not indicated due to an insufficient PPI value (<30%).

Key words: Liver portal perfusion – Sequential scintigraphy – Distal splenorenal shunt – Low-diameter mesocaval interposition shunt

Offprint requests to: K.-J. Paquet

Portal blood flow plays an important role in the maintenance of liver function. The morphological changes, probably in association with humoral factors (although not well determined) that occur in the diseased liver, are responsible for the development of portal hypertension. The hepatic artery gradually becomes the principal source of blood for the diseased liver, and usually only one-third of the blood is transported by the portal vein, which under normal circumstances is responsible for two-thirds of the hepatic blood flow [17]. The introduction of portal systemic shunts to treat portal hypertension has confirmed the observations of Hahn et al. [4], who described the neurological consequences of deviating portal blood flow in healthy dogs. Starzl et al. [23] made important contributions to the study of the “hepatotrophic factors” of the portal vein.

There is no doubt that surgery is the most effective mode of long-term treatment of portal hypertension [13]. Selective and non-selective shunts [3, 13, 24] have shown effectiveness in preventing rebleeding. Selective devices such as distal splenorenal shunts (DSRS) are considered the treatment of choice [7, 10] for portal hypertension, resulting in low rates of rebleeding and encephalopathy involving only the gastroesophageal area, and maintaining the portal flow. Nevertheless, it has been shown that in the late postoperative period, the DSRS shows a tendency to lose selectivity, hemodynamically functioning as a total shunt, particularly in alcoholic patients [5, 6]. In recent
years, evidence of good results from the insertion of (so-called semiselective) portosystemic shunts using low-diameter grafts and the creation of H-shaped interposition shunt has been reported [19, 20]. It seems that the new synthetic PTFE prosthesis enables the placement of small-diameter shunts, resulting in a low thrombosis rate, a decrease in the portal pressure, control of the bleeding and the partial maintenance of portal flow [15, 18, 19].

Liver perfusion scintigraphy has been shown to be an accurate way of measuring portal perfusion [1, 9] in a non-invasive manner. Using this method to estimate liver blood flow and the percentage of portal blood flow, a group of 50 consecutive patients presenting with recurrent hemorrhage from esophageal varices were compared. Between 15 January 1983 and 1 January 1988, 25 subjects underwent placement of distal splenorenal Warren shunt (DSRS) and 25 insertion of a low-diameter mesocaval interposition shunt (LDMIS). The portal perfusion index (PPI) was measured directly preoperatively and at 6, 12, 24, 36, 48, 60, 72 and 84 months postoperatively. Thus, the minimal follow-up period was at least 36 months and the median follow-up, 59 months.

Patients and methods

At the Heinz Kalk Hospital, strict selection of patients for surgical treatment of portal hypertension has been observed since 1975. In brief, they must exhibit good liver function, i.e. a Child-Pugh classification of A or B (Table 1), adequate liver volume, adequate veins for shunt surgery, no stenosis of the celiac axis and/or hepatic artery and good portal perfusion of >10% as measured by liver scintigraphy [12, 14, 16] (Table 2). Patients exhibiting a high portal perfusion rate >30% are generally selected for a Warren shunt so that they receive the benefits of the partial maintenance of portal flow [15, 18, 19].

Liver perfusion scintigraphy was performed in all patients using the technique of Biersack et al. [1] as modified by Sarper and Tarcan [21]. The method and calculations applied to determine the portal perfusion rate have been described elsewhere [1, 9]. As determined at the Institute of Nuclear Medicine (Leszegdina Municipal Hospital, Schweinfurt, FRG), normal portal perfusion values in patients with a healthy liver are 56% ± 5%.

Patients treated with surgery at Heinz Kalk Hospital are followed up at 6 and 12 months postoperatively and once per year thereafter. All subjects undergo flexible endoscopy; encephalopathy is investigated with writing, number-connection and psychometric tests. In doubtful cases, electroencephalography and psychiatric evaluation are performed. The patency of shunts is estimated by means of ultrasound and/or selective angiography. In the present study, five patients who received an LDMIS had originally been scheduled for a DSRS because their PPI value was >30%. Severe chronic pancreatitis was detected intraoperatively and the implantation of a DSRS would thus have been technically difficult. All patients are given a low-protein diet (60 g/day) and lactulose (3 x 10-20 ml/day).

The general characteristics of these patients during the preoperative period were compared, as were the results obtained during the postoperative period, particularly the incidence of rebleeding and encephalopathy and the early and long-term survival. The results of pre- and postoperative liver perfusion scintigraphy were also compared.

Results

Both groups were comparable in the number, age and sex of the patients, the underlying disease and the general features during the early and late follow-up period (Table 3). In particular, no significant difference was noted in terms of rebleeding, encephalopathy or survival. In the group of patients who received the DSRS, no case of rebleeding from esophageal varices or of encephalopathy occurred. One in-hospital death occurred late due to liver failure, and one patient was lost to follow-up. Shunt patency was established in all subjects, either by ultrasound or angiography. The mean preoperative PPI value was 38% (range, 30% to 42%). The value fell to 32% (range, 26% to 36%) after 6 months. Thereafter a continuous decrease to 15% (range, 5% to 22%) occurring up to the beginning of the 8th year post-surgery (Table 4). The difference be-

### Table 1. Modified Child-Pugh classification of patients presenting with liver cirrhosis at Heinz Kalk Hospital, Bad Kissingen. Child A, 6–8 points; Child B, 9–11 points; Child C, ≥ 12 points

<table>
<thead>
<tr>
<th>Observations</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Nutritional status</td>
<td>Excellent (1)</td>
</tr>
<tr>
<td>2. Ascites</td>
<td>None</td>
</tr>
<tr>
<td>3. Neurological disorder (encephalopathy)</td>
<td>None</td>
</tr>
<tr>
<td>4. Serum bilirubin (mg/100 ml)</td>
<td>&lt;2</td>
</tr>
<tr>
<td>5. Serum albumin</td>
<td>&gt;3.5</td>
</tr>
<tr>
<td>6. Prothrombin concentration (Quick test)</td>
<td>&gt;75%</td>
</tr>
</tbody>
</table>

### Table 2. Selection criteria for DSRS and LDMIS operation

1. At least two recurrences of hemorrhage from esophageal varices after continued endoscopic sclerotherapy (sclerotherapy failures)
2. Liver volume of between 1000 and 2500 ml as determined using ultrasound
3. Exclusion of the activity and/or progression of liver disease by laparoscopy and liver biopsy
4. Adequate findings at selective panangiography (splenic, coeliac and mesenteric) and sufficient venous function (good arterial hepatic supply, exclusion of arterial stenosis, measurements of the lumen and of the length of the veins to be shunted)
5. Portal perfusion rate of ≥ 10% as determined by sequential scintigraphy