Objective: To determine rates of survival, long-term patency, and recurrent variceal hemorrhage among patients with alcoholic cirrhosis treated by partial portacaval shunt.

Design: Single-institution cohort follow-up study of 72 consecutive patients who underwent small-diameter portacaval H-graft shunt with collateral ablation during a 10-year period (1981 through 1990). Subjects were enrolled and followed up for up to 15 years. Shunt patency was assessed by portography and/or ultrasonography. We performed 7-year Kaplan-Meier analyses of survival (in 65 patients in Child classes A and B), shunt patency, and absence of variceal bleeding.

Setting: Tertiary academic referral center of the US Department of Veterans Affairs.

Patients: Patients with alcoholic cirrhosis were considered for operation after at least 1 proven episode of variceal hemorrhage. Patients with portal vein thrombosis were excluded; patients in Child class C underwent operation only for compelling indications. Of the 72 who underwent partial shunting, 38 were in Child class A, 27 were in class B, and 7 were in class C.

Interventions: Partial portacaval shunt (6-, 8- or 10-mm polytetrafluoroethylene H-graft with collateral ablation) and serial follow-up.

Main Outcome Measures: Study end points were death, recurrent variceal hemorrhage, and unavailability for follow-up. Other measures included graft patency and nonvariceal rebleeding.

Results: Cumulative probability of 7-year patency for grafts at risk was 95%. The 7-year probability for absence of variceal bleeding in patients at risk was 92%. In 65 patients in Child classes A and B, operative mortality was 7.7% and the cumulative probability of 7-year survival was 54%.

Conclusion: For variceal bleeding associated with alcoholic cirrhosis, the small-diameter polytetrafluoroethylene portacaval H-graft with collateral ablation affords durable patency and protection against variceal rebleeding.

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PARTIAL portacaval shunts are designed to control variceal hemorrhage while preserving portal perfusion of the liver.1-3 Partial shunting is achieved by means of 8- or 10-mm-diameter polytetrafluoroethylene (PTFE) portacaval H-grafts with collateral ablation. Several centers6-9 and our own randomized trial10 have validated the hemodynamic advantage of partial shunts, demonstrating lessened encephalopathy compared with shunts that totally divert portal flow. Since the initial studies were of relatively short duration, legitimate questions were raised regarding long-term control of variceal rebleeding and patency of the small-diameter synthetic grafts. This report of our longitudinal follow-up addresses those questions.

Partial shunts are distinct in concept and hemodynamic behavior from selective and total shunts. The theory of the partial shunt is based on the observation that esophageal varices rarely bleed when the pressure gradient between the portal vein and vena cava is less than 12 mm Hg.11,12 Therefore, the goal is to partially decompress the entire portal system to attain a pressure below the critical threshold, yet high enough to preserve prograde splanchnic nutrient blood flow to the liver. We strive to achieve collateral substitution, an ideal situation in which multiple anastomotic channels feeding thin-walled varices are replaced by a single prosthetic conduit that carries the same volume of blood. By this mechanism, the risk of variceal hemorrhage is minimized while portal hemodynamics are not substantially altered.

See Invited Commentary at end of article

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PATIENTS AND METHODS

PATIENTS AND STUDY DESIGN

These studies were approved by the Subcommittee on Human Subjects at the Long Beach Veterans Affairs Medical Center, Long Beach, Calif. Patients with portal hypertension (caused by alcoholic liver disease in 70 of 72 cases) were considered for inclusion after at least 1 endoscopically verified episode of variceal hemorrhage. All patients who underwent 6-mm (n = 1), 8-mm (n = 35), or 10-mm (n = 36) portacaval H-graft shunts from 1981 through 1990 were enrolled. At operation, the 70 men and 2 women had a mean age of 49.6 ± 10.2 years (range, 31-67 years). Distribution according to Child class was as follows: A, 38 patients; B, 27 patients; and C, 7 patients.

PREOPERATIVE EVALUATION

All patients underwent flexible upper endoscopy at least once to demonstrate the presence and extent of varices as well as to exclude other potential sources of gastrointestinal tract bleeding. Superior mesenteric arteriography with venous phase was performed preoperatively in all elective cases to demonstrate patency of the portal vein and to delineate existing portasystemic collateral channels. History and physical examination, with appropriate laboratory studies, were performed.

Patients were assigned to Child class A, B, or C by one of us (I.J.S. or E.B.R.) on the day of operation on the basis of clinical and laboratory data (ie, serum albumin and bilirubin levels, nutritional state, degree of encephalopathy, and degree of ascites) according to the criteria described by Child and Turcotte.13

The prospective, randomized clinical trial reported in 1994 by Sarfeh and Rypins10 compared 14 patients who underwent partial shunts (8-mm-diameter portacaval H-grafts with collateral ablation) with 16 patients who had total shunts (16-mm grafts). Hepatopetal flow was demonstrated in 93% of partial shunts and 0% of total shunts (P < .001). Encephalopathy-free survival was significantly higher in the partial shunt group. No variceal rebleeding occurred in either group. The conclusions were limited by the short duration of follow-up (24-month Kaplan-Meier analysis).

In the present study, we extend our observations to longer-term clinical follow-up of rebleeding in the 72 consecutive patients who underwent partial shunts in the interval 1981 through 1990.

RESULTS

Follow-up to either death or a specified time interval was 100% to 1 year, 90% to 3 years, and 72% to 5 years. Two patients were followed up for 15 years or more. Follow-up portography was obtained on at least 1 occasion in all surviving patients (except one who consented to ultrasonography).

Operative mortality (all causes within 30 days or during the same hospitalization) was 12.5% overall (9 of 72 patients). Among patients in Child classes A and B, operative mortality was 7.7% (5/65); among patients in Child class C, operative mortality was 57% (4/7) (P < .004 by Fisher exact test).

Excluding operative deaths, overall survival within the follow-up period (mean ± SD) was 46 ± 40 months. The

TECHNIQUE OF OPERATION

The small-diameter interposition portacaval shunt has been described in previous publications.12,13 Briefly, the porta hepatis is approached through an extended right subcostal incision. The portal vein and the anterior portion of the adjacent vena cava are exposed. A short piece of ring-supported PTFE vascular conduit (almost always 8- or 10-mm diameter) is fashioned with bevels oriented at 90° to one another. After impregnation with heparin saline, the graft is anastomosed to the vena cava and portal vein with an everting continuous horizontal mattress suture of 4-0 or 5-0 polypropylene. Collateral ligation is important to redirect blood flow away from preexisting venous channels14 and is accomplished by a combination of operative clipping or ligation and postoperative embolization.

POSTOPERATIVE CARE

Postoperative management emphasizes sodium and fluid restriction. Oral feeding and spironolactone are usually tolerated by the fourth postoperative day. Within the first postoperative week, a portogram is obtained. The interventional radiologist can assess shunt patency and flow patterns, embolize any collateral vessels that may not have been occluded intraoperatively, and provide catheter-directed thrombolysis on occasion. Late shunt patency was assessed by 1 or more of the following methods: portography, duplex ultrasonography, absence of gastroesophageal varices at endoscopy, and autopsy.

STATISTICAL ANALYSES

Kaplan-Meier analyses were performed manually and were validated by means of Prism for Windows, version 2 (GraphPad Software, San Diego, Calif). Other analyses were also performed with Prism for Windows, version 2.
cumulative probability of survival for patients in Child classes A and B is shown in the Figure. Cumulative probability of 7-year patency for grafts at risk was 95% (Figure). Six grafts became occluded by thrombosis perioperatively; all of these achieved long-term secondary patency after catheter-directed infusion of thrombolytic agents to the graft (n=4) or, earlier in the series, operative thrombectomy (n=2). Later thromboses occurred in 3 shunts. One shunt became occluded by ingrowth of hepatocellular carcinoma as demonstrated at autopsy. A second failed after splenectomy. A third thrombosis appeared to be spontaneous.

Four patients had rebleeding from varices as demonstrated at esophagoscopy; the cumulative 7-year probability of absence of variceal rebleeding for all patients was 92% (Figure). One variceal hemorrhage was associated with shunt thrombosis, 1 with ingrowth of hepatocellular carcinoma occluding the shunt (both mentioned above), and 1 with a narrowed shunt as seen at follow-up portography. One patient experienced a self-limited, spontaneous episode of rebleeding despite a patent shunt. Other causes of upper gastrointestinal tract bleeding included diffuse gastritis or gastropathy in 4 patients and 1 case each of arterial bleeding from gastric ulcer and sclerotherapy-related esophageal ulcer.

This study demonstrates the durability and long-term effectiveness of the small-diameter portacaval H-graft with collateral ablation in the management of variceal hemorrhage. The original development of this operation was met with skepticism on 2 main grounds. First, prior experience with the Dacron mesocaval H-graft, which had been frustrated by frequent thromboses,16 suggested that the partial shunt might meet the same fate. Second, it was widely believed that nothing short of total decompression of the portal system would prevent variceal hemorrhage. This longitudinal study, while necessarily limited by some attrition in follow-up, should dispel those concerns.

Some of the differences that, in our experience, account for the greater clinical longevity of the partial shunt compared with earlier mesocaval interposition grafts are as follows:

1. The graft is short and direct.
2. The small diameters promote higher velocity of flow.
3. Expanded PTFE is less thrombogenic than Dacron in our experience.
4. The supporting rings prevent external compression of the graft.
5. The portal vein carries a higher volume of blood flow than the superior mesenteric vein, thus enhancing inflow.
6. Technical nuances, including long anastomotic bevels, everted suture lines, and heparin impregnation of the prosthetic material, made perioperative thromboses increasingly rare and may have aided long-term patency as well.

Given the modern spectrum of medical, interventional, endoscopic, and surgical treatments for variceal hemorrhage, it is impractical for every surgeon to gain experience with all of the varieties of shunt operations. While local expertise will often govern the choice of procedure, the occasional shunt surgeon will naturally gravitate to a proven operation of manageable complexity. The partial shunt offers technical and hemodynamic advantages that recommend its use in good-risk patients with alcoholic cirrhosis. On the basis of these results from the first decade of its clinical application at our institution, we conclude that the partial shunt affords effective and long-lasting relief from variceal hemorrhage.


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REFERENCES


DISCUSSION

Jeremiah G. Turcotte, MD, Ann Arbor, Mich: This paper is a landmark contribution. Dr Sarfeh, his colleagues, and his protégés have been studying this shunt for approximately 20 years.
This paper is 1 of several important contributions by Dr Sarfeh
and is the definitive publication concerning long-term follow-
up in patients with small-diameter portacaval shunts.

Seventy-two consecutive patients undergoing a partial shunt
were followed for 7 to 15 years with a graft patency rate of 93%,
absence of variceal bleeding of 92%, and a 7-year survival of
54% of Child A and B risk patients with alcoholic cirrhosis. These
are excellent results in a very difficult group of patients.

Why does this shunt work? Why is variceal hemorrhage
prevented and postshunt encephalopathy minimized? Sarfeh,
Rypins, Rosemurgy, and others have studied the mechanisms.
A summary is that the shunt diverts some, but not all, of the
portal flow. Total nutrient flow, ie, the sum of both the he-
patic artery and portal flow, actually increases, thus protect-
ing the liver. Portal flow that perfuses the liver remains about
the same. Presumably, the mechanism is that the shunt re-
duces peripheral resistance in the portal system, allowing to-
tal portal inflow to increase. Now there is sufficient inflow to
both supply blood to the liver in about the same amount, plus
provide additional portal blood for diversion through the shunt.
Simultaneously, the pressure in the portal vein and splanch-
ic system decreases, thus preventing variceal hemorrhages.

Experience has demonstrated that if the pressure gradi-
ent between the portal system and the systemic caval system is
about 12 mm Hg, variceal hemorrhage will not occur. The iden-
tification of this principle of a critical gradient by Sarfeh and
his colleagues is probably their most important fundamental
contribution, rather than simply the description of a new op-
eration. Other effective partial shunts that achieve this same
gradient are the small-diameter mesocaval shunt and the so-
called calibrated side-to-side portacaval shunt. These shunts
have not been studied as extensively as the partial portacaval
shunt of Sarfeh.

I agree with the authors that shunts should be performed
more often than they have been in recent years. Shunts are in-
dicated only for Child A and selected Child B patients who bleed
despite sclerotherapy and who are unlikely to have a liver trans-
plant in the near future. The results of shunts in these patients
are at least equivalent to that of liver transplantation. Moreover,
the waiting list for liver transplant has increased over 300% be-
tween 1992 and 1996. The number of transplants being per-
formed has only increased about 30%. In 1992 there were 2323
patients awaiting liver transplants, and at the end of 1996, there
were 7467 awaiting a liver transplant. Waiting times are now well
over a year in many programs. Donor livers should be con-
served for patients who do not have any other options. Tran-
sjugular intrahepatic portosystemic shunt, in its present state of
development, has proved to have a high rate of thrombosis and
does not seem to be a permanent solution for most patients.

I have some questions for the authors. What do you think
of the small-diameter mesocaval and the calibrated side-to-side
shunts? Do you have any idea how many of your patients stopped
drinking and how many had hepatitis C? Liver transplant pro-
grams have the opportunity to follow these people for long pe-
riods before they are transplanted. It has become evident that if
patients stop drinking, their liver function often improves and
they may not need a transplant. Post-shunt abstinence may par-
tially account for the good long-term results in your series.

C. Wright Pinson, MD, Nashville, Tenn: I have 3 ques-
tions for the authors. The first concerns a technical issue: why
do the authors think they had those few early thromboses? In
the number who did thrombose, some of them were repaired
operatively and 4 of them received lytic therapy. I am curious
about the details of deciding on dealing with it operatively vs
lytic therapy, and I am interested in the details of the lytic
therapy.

Second, do the authors feel that, for those patients who
might potentially be liver transplant candidates, this shunt is
equally as good in the mesocaval position as it is in the porta-
caval position?

Third, regarding documentation of portal flow: would they
discuss that briefly?

Dr Sarfeh: Dr Turcotte, you asked about the 2 other types
of partial shunts. We do not do the small-diameter mesocaval
shunt. This requires a much longer graft. The distance be-
tween the mesenteric vein and the vena cava is far greater than
the short 3 to 5 cm between the portal vein and vena cava. Sec-
ond, the portal vein carries more blood flow than the mesen-
teric vein. The more blood you can get into the shunt, the greater
the longevity of the shunt. For these reasons, we have avoided
the mesocaval small-diameter graft, but I am aware of the fact
that other centers have success with it and we wish them con-
tinued success.

In terms of the calibrated direct side-to-side portacaval
shunts, we know that direct venovenous anastomoses expand
with time as first described by Henri Bismuth. Therefore, they
do not maintain their initial resistance. Second, length is an added
increment of resistance to our shunt, and that is important in
preserving more flow to the liver.

Dr Pinson asked about the early thromboses and opera-
tive vs lytic therapy. Initially, we thought these required reop-
eration. However, our angiographer began to use the method
of placing a catheter venously through the femoral vein,
introducing it into the shunt and injecting low-dose strepto-
kine into the clot and dissolving it. This obviated the need
for reoperating on the patients. Our experience has been that
once the perioperative thrombosis is corrected, the graft stays
patent for life.

In terms of preparation for liver transplantation, is it bet-
ter to do a mesocaval shunt? In the portacaval position, Henri
Bismuth, who does this operation, has stated that he actually
cuts the graft during transplant and uses the end of it as the
venovenous bypass. I do not really see that the partial shunt
makes transplantation as difficult as some transplanters feel it
might. There might not be enough experience to confirm or
refute my thoughts on this issue.

Regarding documentation of portal flow, our early stud-
ies went into documenting the amount of portal flow postop-
eratively using clearance techniques with various first-pass sub-
stances and also using macroaggregated albumin injected into
the liver via the shunt. These studies all showed continued he-
patic portal perfusion postoperatively.

Finally, Dr Turcotte, it is difficult for me to ascertain how
many of our patients have stopped drinking. I do have the im-
pression, however, that most of our patients surviving beyond 7
years are abstinent. We had not tested routinely for hepatitis C.