

Results of Interposition "H" Grafts for Portal Hypertension

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During the past nine years, 54 patients underwent interposition graft shunting for variceal bleeding in 48 and intractable ascites in six, either electively (35 instances) or as an emergency (13 instances). Autogenous jugular was used in 41 instances, homologous vena cava in nine and Dacron® in five. The interposition graft was placed between superior mesenteric vein and vena cava in 36 instances and the portal vein and vena cava in 19. Using Child's Clinical Classification 44 were Class C and 10 Class B. There were six (11%) operative deaths with one (2.4%) in the elective and five (38%) in the emergency group. Encephalopathy was seen in 4 (10%) of those surviving more than one year. Two Dacron and two homografts thrombosed. Eight of the autografts were patent at autopsy, 18 on angiography and 15 assumed to be patent because patients were asymptomatic. Only one of 12 late deaths was related to graft failure. Apparently the operation controls ascites and the autogenous jugular vein is the ideal material. Interposition "H" grafting is a simple safe procedure that can be used for portal decompression in patients with bleeding varices.

AN ANASTOMOSIS BETWEEN the portal and systemic venous circulations was first performed by Eck in 1877.⁵ He suggested that this technic might be useful in treating patients with ascites. The operation was attempted by a number of surgeons, mainly in Europe, but generally with poor results. The first successful series of portacaval shunts were described by Blakemore and Lord² and Whipple⁴³ in 1945. Unfortunately, surgical decompression by direct portacaval anastomosis is frequently difficult to accomplish because of congestion of the liver with hypertrophy of its caudate lobe, arteriovenous fistulas in the retroperitoneal area, enlarged lymphatics and edema about the

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porta hepatis or, especially in children, thrombosis of the portal vein. Transection of the inferior vena cava with suturing of the orifice of the proximal segment into the side of the superior mesenteric vein was introduced by Valdoni⁴⁰ in 1954. It was later popularized by Marion²⁴ and Clatworthy,⁷ as another site for portal decompression.

Although the mesocaval shunt is almost uniformly applicable, as thrombosis of the superior mesenteric vein is rare, Gliedman and Margulies¹⁶ as well as Voorhees and Blakemore⁴¹ have noted marked swelling of the lower extremities, especially in the adult alcoholic with hypoproteinemia. Therefore, in an attempt to leave the venous return from the lower half of the body unimpaired as well as to simplify the operative procedure and perhaps reduce its mortality and morbidity especially in alcoholics whose variceal bleeding does not respond to non operative management, we adopted in 1968 the routine use of the Interposition "H" Graft. Interposition of an autogenous vein between the portal and systemic venous system was first carried out in 1951 by Reynolds and Southwick.³² Isolated cases were reported in the 1960's using prosthetic material, by Yeoh and Eiseman,⁴⁴ Foster et al.,¹³ Preston and Trippel²⁸ and Nabseth and associates.²⁶ We first used venous homografts to bridge the gap between the two circulations.³¹ Lord et al.,^{19,20} Drapanas,^{9,10} and Giles and associates¹⁵ advised the use of prosthetic materials. More recently Thompson and Read³⁷⁻³⁹ as well as Stipa et al.^{35,36} have employed autogenous jugular vein. Dale and Scott⁸ and Betancourt and associates¹ have shown in experimental animals that autogenous grafts evoke the least perivascular reaction and is the most satisfactory material for venous grafting when compared to homograft and prosthetic material.

Materials and Methods

During the past nine years, 55 interposition "H" grafts between the portal and systemic venous circula-

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tions have been performed on 54 patients. Forty-six were white and eight black. There were 48 men and six women whose age ranged from 21 to 70 years with an average of 49. In 48 patients, cirrhosis was secondary to alcoholism while in six it was postnecrotic. All but six of the 54 patients had had up to seven episodes of massive hemorrhage and received from 1,500 to 35,000 ml of blood prior to operation. The six exceptions were patients operated on for ascites intractable to diuretics and salt restriction. Thirteen of the 49 shunts were performed during an acute episode, while the other 36 were delayed two to six weeks. Fifty patients had clinical evidence of ascites prior to surgery.

Results of liver function studies were abnormal in all. Total serum protein levels ranged from 3.4 to 7.8 g/100 ml while the serum albumin levels varied from 1.2 to 3.7 g/100 ml. Sulfobromophthalein retention measured 10–45%. The serum bilirubin level was within normal limits in three patients, while it varied from 2.0 to 34.0 mg/100 ml at the time of operation in the others. With the exception of the six patients operated on for ascites, all patients showed esophageal varices on either esophagoscopy, portal venous angiography or barium studies. Using Child's method of clinical evaluation,⁶ we placed 44 patients in Class C and ten in Class B.

Operative Technique

An incision is made, on the right side of the neck parallel of the anterior border of the sternocleidomastoid muscle, extending from the base of the skull to the suprasternal notch. The internal jugular vein is identified in the carotid sheath and dissected free from the vagus nerve and common carotid artery. The vein is then ligated at each end and removed for use as an autograft. The vein varied from 7.5 to 10.0 cm in length with a diameter of 1.0–2.0 cm. Autogenous jugular vein was used on 41 occasions, homologous vena cava was employed earlier in nine and Dacron® in five of the emergencies.

In 36 instances, the interposition graft was placed between the superior mesenteric vein and the inferior vena cava, in 19 it was situated between the portal vein and inferior vena cava.

For mesocaval interposition, a long midline incision is made. The transverse mesocolon is elevated superiorly and the small bowel retracted downward. Portal pressure is measured in a small venous tributary of the midcolic vein dissected out in the transverse mesocolon. The superior mesenteric vein is then identified at the right border of the mesentery adjacent to the pulsation of the artery and examined for patency. The inferior vena cava is then identified by retracting the small bowel to the right and superiorly, exposing the

cava at the brim of the pelvis just after the confluence of the iliac veins. The anterior surface is cleaned for a distance of 2–3 cm so that a partially occluding clamp can be applied after systemic heparinization. Heparin sodium 120U/Kg is given intravenously and activated clotting times monitored at 20 minute intervals. We attempt to prolong the activated clotting time 200% during vascular anastomosis. The activated clotting time is returned to normal following completion of the anastomosis by giving intravenous protamine sulfate in 20 mg increments. After the partially occluding clamp is applied to the vena cava, an ellipse of this vessel is excised the autograft is then sutured to the vena cava with a continuous 5-0 prosthetic monofilament material. The peritoneum over the superior mesenteric vein is opened and the vein is isolated dissecting out the confluence of the mid colic and inferior pancreatic branches above and below the right colic tributary. The dissection is limited superiorly by the pancreas, which should not be injured, and inferiorly by the right colic artery crossing anteriorly. There is some variation in the length of the vein but it has always been adequate for anastomosis. A finger is then passed through the right colic mesentery inferior to the transverse portion of the duodenum to join the two dissections. The graft is allowed to fill with blood under pressure which rotates it slightly and prevents kinking as it passes caudal to the duodenum to enter the superior mesenteric vein. A small ellipse of the superior mesenteric vein is removed posterolaterally after blood flow has been controlled by vascular clamps. The posterior row of the anastomosis is completed with 5-0 prosthetic material. After removal of the clamp on the graft to assure patency, the anterior anastomosis is completed with a continuous suture (Fig. 1).

For portacaval interposition the patient is placed in the left lateral position with the kidney rest elevated. A long skin incision is then made starting just below the xiphoid and parallel to the costal margin all the way around the flank to the transverse process of the second lumbar vertebra. The subcutaneous tissues and underlying muscles are divided transversely. Any ascitic fluid is then aspirated. The peritoneum over the porta hepatis is incised to expose the right lateral portion of the portal vein. Pressure in the portal vein is measured by direct insertion of a needle. After giving the sodium heparin 120 U/kg, a Satinsky vascular clamp is applied to the portal vein and an ellipse of this vessel is removed. The autogenous jugular vein is sutured to this defect in the portal vein with an anterior and posterior whipping stitch of 5-0 monofilament prosthetic suture. The occluding clamp is then removed. The posterior peritoneum is then incised over the anteriomedial wall of the inferior vena cava for a distance of 2–3 cm.

A partially occluding clamp is applied to this vessel and a button of tissue is removed from the vena cava. The posterior anastomosis is made with a continuous 5-0 monofilament prosthetic material. The clamp on the graft is removed to assure patency and the anterior anastomosis is then completed. Post-shunt pressures are then taken in both the portal and caval systems. When any doubt exists about shunt flow an angiographic study is performed before abdominal closure (Fig. 2).

Results

Six of the 54 patients died within one month of their interposition graft. Five of these deaths were in the 13 patients operated on as emergencies while bleeding. Four seemed to do well after surgery only to develop deepening icterus, ascites and somnolence. They died on the eleventh, fourteenth, twenty-first and twenty-seventh days. Two others died on the sixth and tenth postoperative days. Both of these had markedly increased pressure in their vena cavae at the time of surgery (240 and 400 mm H₂O). After their shunts were completed the pressure in the portal system fell only minimally. Both showed progressive liver failure, ascites and decreasing urinary output despite large amounts of fluid and albumin replacement. At autopsy there was almost complete occlusion of the inferior vena cava by an hypertrophied caudate lobe in both. In one the Dacron mesocaval graft was found to be thrombosed.

Three additional patients have had thrombosis of their interposition grafts. Two patients who had "H" grafts tunneled between the duodenum and pancreas developed hematemesis six and nine months after surgery. The first patient, at six months was found to have a splenic pulp pressure of 35 cm of saline and occlusion of the graft on splenoportography. At a second operation the thrombosed homograft was removed. It was occluded by a swollen pancreas and a second homograft was inserted as an interposition "H" graft caudal to the duodenum. He is asymptomatic 98

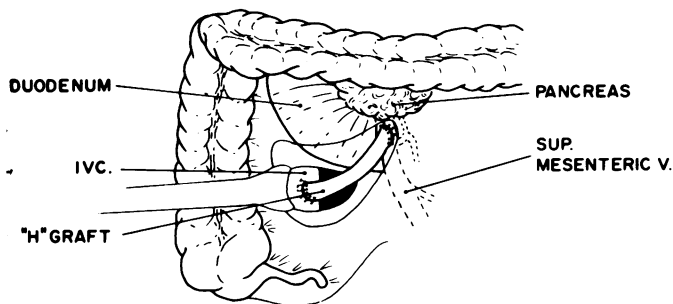


FIG. 1. Interposition autogenous jugular vein inserted between the superior mesenteric vein and inferior vena cava.

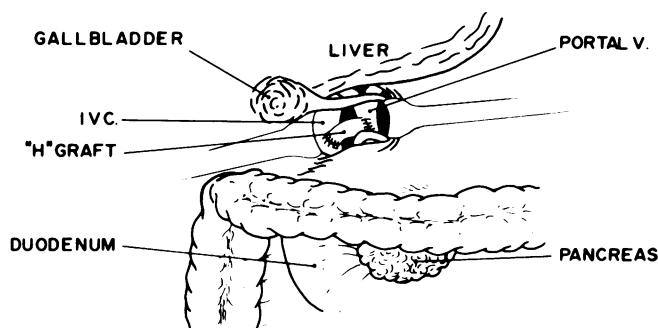


FIG. 2. Autogenous jugular vein inserted as an "H" graft between the portal vein and inferior vena cava.

months after surgery. The second patient refused further surgery only to return to the hospital six weeks later and died as a result of variceal hemorrhage. At autopsy there was evidence of pancreatitis with resulting fibrosis occluding the homograft. The third patient had an uneventful postoperative course following a Dacron interposition portacaval procedure. He returned six months later with ascites, progressive icterus and massive upper gastrointestinal tract bleeding. He died shortly after admission. His graft was found to be thrombosed at autopsy.

Three patients developed hepatomas at four, six and 18 months after operation. Two had cirrhosis secondary to alcoholism and in the third cirrhosis was secondary to hepatitis. All three recovered uneventfully from their operations only to return later with progressive icterus, ascites and terminally, somnolence, generalized bleeding, coma and death. The interposition grafts were patent at autopsy in all three.

Seven patients died from six to 38 months after interposition grafting. They continued heavy alcohol intake. Two died at 30 and 34 months from aspiration pneumonia. Three other patients developed hepatorenal syndrome and died at 16, 22 and 38 months; complete destruction of the liver apparently due to continued alcoholism was found at autopsy. Two other patients died from complications of duodenal ulcer. The first died six months after "H" grafting from peritonitis secondary to an acute duodenal ulcer perforation. He had perforated his ulcer at home and was not seen by a physician for some 96 hours when he was terminal. The second patient developed massive gastrointestinal hemorrhage while being treated for acute alcoholism. He died without surgical consultation 32 months after shunting and at autopsy was found to have a large duodenal ulcer from which he had bled. The grafts were patent in all seven of these patients.

Six of the 46 long-term survivors (6-104 months) have had melena or hematemesis since surgery. Gastrointestinal tract barium studies as well as endoscopic

examination have demonstrated duodenal ulcer in four patients and hemorrhagic gastritis in two. Splenoportography by direct splenic injection and more recently using delayed films after selective splenic artery injection, have shown the shunts are patent in the 18 visualized. In all 30 survivors operated on for varices, these have decreased in size as determined by barium studies.

Four patients have been readmitted for mental confusion, somnolence or coma associated with elevated serum ammonia levels. Three of these have had a single episode of encephalopathy; one at two months and two at three months following the shunt procedure. All three were treated with protein restriction and lactulose 30 ml three times daily and are doing well nine, 12 and 16 months later. The fourth patient has had two episodes of encephalopathy two and four months following his shunting procedure. He was initially felt to have cirrhosis secondary to hepatitis. He continues to have a positive HAA and is felt to have chronic active hepatitis and in addition to protein restriction is being given azothioprine, prednisone and lactulose.

Immediately after operation there is frequently a transient increase in ascites and icterus. If severe enough this can lead to death as indicated previously. We have had an example of this in a long term survivor who developed increasing ascites, deepening icterus and decreasing urinary output after mesocaval shunt. His liver function studies finally improved after four months of intensive fluid therapy.

All six patients operated on for intractable ascites are now working and are free of intra-abdominal fluid. Their ascites is easily controlled by either salt restriction or mild diuretics. No complications have been associated with removal of the jugular vein and the scar has not been disfiguring.

Discussion

Interposition grafting for portal hypertension has been performed for almost 30 years.³² Considerable experience has been gained using autografts,³⁶⁻³⁹ homografts³¹ and prosthetic material.^{9-11,15,19,20} There is increasing evidence that, contrary to previous opinion,^{23,34} this procedure is not just a variant of side to side portacaval anastomosis. It appears that, different to the latter, some portal flow to the liver is maintained as shown previously by angiographic studies by Read et al.³¹ and in 44% of 80 patients by Drapanas.¹⁰ More recently Harmon et al.,¹⁷ using radioactive microspheres in experimental animals, have shown that after side-to-side portacaval shunt no blood goes to the liver while interposition mesocaval and portacaval shunts resulted in preservation of 23-70% of hepatic portal

blood flow. This continued oxygenation and nutrition of hepatocytes apparently preserves the remaining liver function and thus helps to prevent liver failure and encephalopathy. Encephalopathy was seen in only four (10%) of our 42 survivors, followed for more than a year, and was easily controlled by diet and lactulose therapy. This low incidence of encephalopathy associated with interposition grafting has previously been noted by Drapanas¹ et al.,^{9,10} Lord et al.,^{19,20} Stipa et al.^{35,36} and Filtzer et al.¹⁵

Patients with bleeding esophageal varices are such poor operative risks that every effort should be made to avoid surgery. Despite the use of balloon tamponade, fresh whole blood and vasopressin, we found it necessary to operate on 13 patients to prevent exsanguination. Five (38%) died in the early postoperative period. This mortality is less than the 57% reported by Prandi et al.²⁷ when emergency portacaval shunting was carried out and the 45% reported by George et al.¹⁴ and 55% reported by Pugh²⁹ when variceal ligation are so disappointing that a "jump" graft from the portal to systemic circulation should be used in emergency situations to treat variceal hemorrhage. There is no doubt that interposition grafting requires less dissection, fewer transfusions and less anesthesia than either direct mesocaval or portacaval anastomosis. Early in our study we used prosthetic material in emergencies but became disappointed with the results as two grafts clotted early. We now use the interposition autograft exclusively when operating for acute bleeding.

In our 42 elective operations there was one hospital death (2.4%). This low mortality is in agreement with Drapanas et al.,^{9,10} and Fitzler et al.¹⁵ using prosthetic material and Stipa et al.³⁶ using autografts for interposition. Which material should be used for the "H" graft? Lord et al.^{19,20} using Teflon[®] for mesocaval interposition had one instance of occlusion in seven patients observed up to 20 months while Drapanas et al.¹⁰ reported a 95% patency rate in 80 patients followed up to five-and-one-half years. Thrombosis occurred in two of our five patients with Dacron grafts. Technical factors can contribute to thrombosis. Drapanas⁹ pointed out the necessary rotation required to relate the conformity of the vena cava and mesenteric vein. We found interpancreaticoduodenal placement to be thrombogenic because of compression from both hemorrhage and pancreatitis.³¹ Autogenous vein is pliable, flexible and causes less tissue reaction than prosthetic material which is more likely to kink and is known to produce mural thrombi. We now use autogenous jugular vein exclusively.

The use of autogenous internal jugular vein as an "H" grafting material seems ideal. It is always available, easy to obtain, is "surplus" and as previously

shown experimentally by Dale and Scott⁸ as well as Betancourt et al.¹ evokes the least tissue reaction and is, therefore, less likely to clot. In all our cases it has been long enough to bridge the defect and is of sufficient diameter (1 cm or greater) to shunt an adequate amount of blood to reduce portal pressure significantly but yet allow some continuing hepatic portal blood flow. There have been no known occlusions in the seven years since we have used autogenous vein. Eight such grafts were found patent at autopsy, 18 on angiography and 15 other patients remain asymptomatic. Although we have used the mesocaval rather than the portacaval shunt exclusively since 1975, as it is easier to perform, one must be prepared to perform either since rare anomalies of the mesenteric vein and its tributaries apparently exist,¹⁸ even though we have not encountered them, and may produce technical problems and prolong the procedure in these debilitated patients. Theoretically, the mesocaval shunt is to be preferred over the portacaval shunt because it prevents augmentation of the hyperdynamic state seen in cirrhotic patients and is more likely to protect against post-shunt encephalopathy. However, with equal numbers (19 of each) of mesocaval and portacaval "H" shunts we noted no difference in the incidence of encephalopathy or long term survival.³⁹ Reynolds,³³ Bismuth et al.,³ and Burchell et al.⁴ have pointed out that the type of shunt, whether partially or totally diverting, had little to do with the eventual outcome in these alcoholic patients.

Hypertrophy of the caudate lobe in cirrhotic patients may cause marked caval hypertension (pressure greater than 240mm H₂O).^{25,42} When standard portacaval shunting is carried out resulting decompression is minimal. In two of our patients with interposition grafting the fall in portal pressure was negligible and in the postoperative period both had increasing ascites and icterus with associated renal failure that resulted in death. Interposition as well as standard portacaval shunt is contraindicated if the vena cava pressure exceeds 240mm H₂O. Other procedures such as interposition grafting between the splenic vein and left inferior pulmonary artery¹² or the splenic vein-right atrial shunt²¹ may prove to be a more satisfactory solution to this complicated hemodynamic problem.

Lord et al.²⁰ and Drapanas et al.¹⁰ and Filtzer et al.¹⁵ report few complications follow interposition grafts. Most of our patients continue to drink heavily after their operations and we, therefore, see not only the complications usually noted after direct shunts but also those of alcoholism. Duodenal ulcers have developed in six patients leading to death from hemorrhage in one and perforation in another; bleeding from alcoholic gastritis was seen in two, fatal pancreatitis in one and deteriorating liver function, aspiration pneumonia, and

eventually death in five additional late survivors. It is of particular interest that three patients developed primary carcinoma of the liver and died within two years of operation. Purtilo and Gottlieb³⁰ have reported that cirrhosis and hepatoma are increasing in the United States. They further noted that an average of eight years ensued from the onset of alcoholic cirrhosis and the appearance of hepatoma in 23 patients. MacDonald²² has reported variceal hemorrhage associated with hepatoma in 16%. We recommend that the liver be carefully examined and biopsy be performed at the time of shunting to rule out this entity.

In conclusion, our experience with the principle of interposition "H" grafting coupled with that of others indicates that this is an acceptable means of simplifying the operation for portal decompression. The incidence of post shunt encephalopathy is low possibly due to continued perfusion of hepatocytes via the portal vein. Long term data are difficult to accumulate and evaluate because other aspects of these patients disease, especially alcoholism, lead to death from causes other than bleeding.

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DR. JERE W. LORD, JR. (New York, New York): These two papers by Dr. Thompson and Dr. Cameron are most provocative, and bring up so many points that I'd like to just touch on three at this time.

They emphasized not operating on emergency cases. I agree that one should control the hemorrhage in every possible way, rather than go ahead and do an emergency shunt. Dr. Orloff's data, which is based on operating as an emergency on every patient, reveals a 48% hospital mortality. If we select patients, and treat some of them conservatively during the emergency phase and operate electively, or semielectively, as Dr. Cameron pointed out, the mortality rate is a great deal lower.

Secondly, the concept of evaluating hepatic reserve by Child's method is important. I think the A and B patients should be operated upon, and the C's should be treated conservatively, if possible; and in some of these it is possible to bring them into a B status, and lessen the risk. The last point I would like to make is with regard to the material used for the interposition shunt. Dr. Giuseppe Rossi, one of my colleagues, did the first interposition shunt in this country, I believe, if not in the world, in 1964, as an emergency and used woven Teflon. My interest in the interposition shunt first came in 1967. I had the privilege of being a visitor at the Union Memorial Hospital in Baltimore and an excellent senior

resident was planning to do a portacaval shunt. Instead I persuaded him to do an end-to-side mesocaval shunt. After one hour of trying to get enough length of the inferior vein to make this union, I wished to heaven I'd allowed him to do the end-to-side portacaval. In any case, ultimately he did an excellent job, and the patient did well. I learned subsequently that he decided, after this experience to go into hand surgery. I'm referring to Dr. Shaw Wilgis who is one of the new members of this Association.

After getting home, I then started to use woven Teflon and Drs. Rossi, Daliana and I have a series of 45 patients. In 19 of them, which were performed as emergencies, the mortality rate was approximately 50%. In the other 26, performed electively or as semiemergencies, there was one death. There have been five closures, two due to poor surgical technique. In one the graft was placed above the duodenum and below the pancreas and this probably kinked and thrombosed. The other technical failure was due to the inadvertent suture of the two sides of the prosthesis, which is not recommended. The other three closed spontaneously, after proven patency by angiography, some time between four weeks and two years.

Eighteen millimeters woven Teflon is the same size as the 18 mm Dacron that Dr. Cameron referred to and Dr. Drapanas used. We have used in femoro-popliteal arterial bypasses during the last