

637

Extrahepatic Complications of Liver Transplantation

R. PATRICK WOOD, M.D., BYERS W. SHAW Jr., M.D.,
and THOMAS E. STARZL, M.D., Ph.D.

Few operative procedures performed today subject a patient to such extensive physiologic stresses as does liver transplantation. In addition, patients with end-stage liver disease are often nutritional cripples and profoundly debilitated before being subjected to an operative procedure of immense proportions. These patients are expected not only to recover from the operative procedure, but also to do so under the added stress of immunosuppression.

It is therefore not surprising that, in a review of 225 randomly selected patients receiving transplants at the University of Pittsburgh between June 1982 and January 1985, only 12.8% recovered without at least one significant complication. A review of the patient's hospital and office records was used to identify complications. The age range of the patients studied ranged from 1 to 56 years. Thirty-eight patients required a second liver transplantation and nine patients underwent three liver transplantations. The follow-up ranged from 6 months to almost 3 years. The actual mortality rate for these patients was 28%.

Although these patients had numerous minor complications, only those complications that required additional therapy or prolonged a patient's hospital course were considered significant in this review. As is true for any retrospective chart review, the actual incidence of any complication may be higher than the incidence reported, since the identification of a complication requires that it be recorded in some manner in the patient's chart and identified by the reviewer. This article will not deal with those complications directly related to the hepatic allograft, such as the incidence of rejection,

retransplantation, or hepatic artery thrombosis, because these subjects are presented in other articles in this issue of *Seminars*.

All body systems are stressed in patients undergoing liver transplantation, either by the severe pre-existing liver failure, during the operative procedure itself, or in the postoperative period. Those body systems most often affected will be considered individually.

PULMONARY COMPLICATIONS

Infection

The most common pulmonary complications were infections. A total of 42 patients (18.7%) in this series had pulmonary infections, including pneumonia, empyema, and lung abscess. The infectious causes included a variety of bacterial, viral, and fungal agents, as well as *Legionella* and *Pneumocystis carinii*. Isolated bacterial pneumonias occurred in only five patients and comprised only 11.9% of the pulmonary infections. However, bacterial pneumonia was frequently present in patients dying of multisystem failure in the intensive care unit after liver transplantation. Herpetic and cytomegalovirus (CMV) infections also comprised 11.9% of the pulmonary infections, and 26.2% (11 patients) of these infections were secondary to *Pneumocystis*. Only 2 of the 11 *Pneumocystis* infections occurred in the immediate post-transplantation period. More commonly, in 9 of the 11 patients, these infections occurred after discharge from the hospital in patients with well-functioning hepatic allografts. *Legionella* infections were relatively rare and occurred in only four patients, but resulted in significant morbidity in three of the four patients. The incidence of clinically significant pulmonary fungal infections was difficult to determine because *Candida* overgrowth of the tracheobronchial tree

From the Department of Surgery, University of Pittsburgh Health Center, University of Pittsburgh, Pittsburgh, Pennsylvania.

Reprint requests: Dr. Wood, Dept. of Surgery, 3601 Fifth Ave., Room 103, Falk Clinic, Pittsburgh, PA 15213.

was common in these patients, especially those experiencing serious complications. However, at autopsy, seven patients were proved to have severe *Candida pneumonia*, four patients had significant aspergillosis infections, and two patients had lung abscesses, one with *Cryptococcus* and one with *Mucor*.

Pleural Effusions

Pleural effusions occur in almost all patients undergoing liver transplantation. However, only 40 patients (17.8%) in this series required a thoracentesis or placement of a chest tube as treatment for the effusion. The remaining patients either had spontaneous resolution of the effusion or responded to diuretic therapy. Eight patients had significant complications related directly to the treatment of the effusions. These complications included bleeding requiring thoracotomy in two cases and pneumothorax occurring in six patients during either thoracentesis or chest tube removal.

Atelectasis

Atelectasis of a segment or of a complete lobe results in significant respiratory embarrassment in these already compromised patients. Over the last several years fiberoptic bronchoscopy has been utilized for all patients with atelectasis unresponsive to the usual methods of pulmonary toilet. Of the patients in this series, at least 45 (20%) underwent fiberoptic bronchoscopy. The actual incidence may be higher, since this procedure is often carried out repetitively at the bedside in the intensive care unit until there is complete resolution of the atelectasis. The aggressive application of this useful technique may have contributed to the relatively low incidence of pneumonia in this series of patients.

Respiratory Failure

Severe respiratory failure in patients having liver transplantation leads to long-term ventilator dependency. Two patients in this series had vocal cord paralysis secondary to prolonged intubation. In order to avoid this complication, tracheostomies are performed early in the course of patients who seem destined to have prolonged respiratory failure. Tracheostomies were performed in 25 (11.1%) patients, and there were no operative complications. Of the patients who required a tracheostomy, more than 50% eventually died.

Miscellaneous

Other isolated pulmonary complications included seven patients who had severe aspiration pneumonia requiring reintubation and mechanical ventilation, three patients who required multiple chest tubes for persistent pneumothorax (no patient required thoracotomy), two patients who required thoracotomy for vascular injuries that occurred during central line placement, one patient who required extensive debridement of his chest wall for infected costal cartilages after thoracotomy, and one patient who required multiple thoracotomies for persistent bleeding after 12th rib resection for a left subphrenic abscess.

GASTROINTESTINAL TRACT COMPLICATIONS

Gastrointestinal tract complications can be divided into those occurring spontaneously or those secondary to technical complications in the performance of the liver transplantation.

Technical Complications

Bleeding

The most frequent technical complication was bleeding requiring reoperation in the early postoperative period. This occurred in 19 patients (8.4%). Bleeding was most often diffuse (15 patients) and related to a continued coagulopathy, with multiple areas of oozing identified. Correction of the coagulopathy coupled with oversewing of all bleeding points was usually successful in stopping the hemorrhage. However three patients required multiple explorations for continued bleeding despite the fact that no specific bleeding site could be located at the time of exploration. These patients did poorly, with all three dying of sepsis in the early postoperative period. True surgical bleeding occurred in five cases and was related to bleeding at the vascular anastomoses in four patients. Two of these patients also had bleeding from the right adrenal gland, which may have been injured during the recipient hepatectomy. One patient experienced early postoperative hemorrhage when a tie came off the splenic artery stump on the donor liver. If a specific site of hemorrhage was identified at the time of reexploration, no patient required an additional operation for persistent bleeding. However, reexploration for postoperative hemorrhage from any cause carried a poor prognosis, with 26% of

the patients in this series who died having required reexploration for bleeding in the early postoperative period.

In the later postoperative period six patients died as the result of massive hemoperitoneum. In three of these patients the bleeding was the result of disruption of the arterial reconstruction and in one case disruption of the portal vein. Of these patients three were in the intensive care unit with peritonitis and overwhelming sepsis at the time of the rupture of the vascular anastomosis, but one was several months post-transplant when the arterial reconstruction ruptured. This patient had received a full course of amphotericin therapy for *Candida* peritonitis, which occurred after a retransplantation for arterial thrombosis. A mycotic aneurysm of the arterial reconstruction was identified at autopsy. One patient required exploratory laparotomy for bleeding after a percutaneous liver biopsy, and eventually died of sepsis; a second patient developed a choledochohepatic artery fistula and died 10 days after repair of the fistula of rupture of the arterial reconstruction. Another patient who had received two liver transplants was noted on a follow-up computed tomography (CT) scan to have a pseudoaneurysm of the arterial reconstruction. After angiography confirmed the presence of the pseudoaneurysm, it was successfully repaired. Intraoperative cultures were negative and the patient remains well.

Problems with the Biliary Anastomosis

The 225 patients in this series underwent a total of 287 biliary reconstructive procedures. Of these, 174 were duct-to-duct choledochocholedochotomies and 113 were Roux-en-Y choledochojejunostomies. Duct-to-duct reconstruction over a T-tube stent was attempted whenever possible and there were 24 complications in the 174 duct-to-duct reconstructions (13.8%). There were 16 *bile leaks*; of these six were repaired, six required conversion to a Roux-en-Y choledochojejunostomy, two eventually healed after external drainage was established at operation, and two required replacement of a dislodged T-tube. Seven patients developed *strictures* after duct-to-duct reconstructions; four required operative revision to Roux-en-Y choledochojejunostomies and the other three underwent successful percutaneous balloon dilation of the stricture. One patient who had undergone duct-to-duct reconstruction over an internal stent required endoscopic removal of the stent more than 2 years post-transplantation because the stent was felt to be the cause of recurring hematuria. Following removal of the stent, the pa-

tient was found to have developed common bile duct stones and the duct-to-duct reconstruction was converted to a Roux-en-Y choledochojejunostomy. Of the 113 Roux-en-Y choledochojejunostomies performed, complications developed in 13 patients (11.5%). Seven patients developed leaks at the jejunojejunostomy and two of these patients also had leaks at the choledochojejunostomy. These patients required operative revision or repair of these leaks. Four patients developed strictures at the choledochojejunostomy, two of which were successfully dilated percutaneously and two of which required operative revision. Two patients developed biliary obstruction secondary to retained internal stents. One patient underwent successful endoscopic removal of the retained stent, but the other patient required operative removal of the stent. Cholangitis occurred in 10 patients and was most common in patients with T-tubes in place in which the T-tube was felt to be causing partial bile duct obstruction (seven cases). Three patients with strictures at the site of the choledochojejunostomy developed cholangitis.

Infection

Intra-abdominal infections were infrequently seen in patients who had not had a major complication. An aggressive attempt was made to identify intra-abdominal infections in patients who showed signs of sepsis without an obvious source. This is reflected in the fact that eight patients underwent negative exploratory laparotomy for suspected intra-abdominal infections. Isolated, localized intra-abdominal abscesses were identified in 23 patients (10.2%). These included 12 patients with right subphrenic abscesses, six patients with subhepatic abscesses, and five patients with left subphrenic abscesses. In only three cases did these infections develop in patients whose postoperative course had been totally benign. Percutaneous drainage of these abscesses was attempted in three patients and was successful in one. All other patients were explored and drained. More common in these patients was the development of diffuse peritonitis without localization of the infection. This occurred in 34 patients (15.1%). Eight of the patients who originally presented with localized abscesses eventually developed diffuse peritonitis. Diffuse peritonitis was associated with either technical complications (anastomotic leak, reexploration for bleeding, arterial thrombosis) or with failure of the allograft to function adequately (rejection, primary nonfunction of the allograft, hepatitis) in 31 of the 34 patients. Isolated bacterial peritonitis occurred in only six patients.

However 11 patients had peritonitis secondary to multiple organisms, including both bacteria and fungi. Isolated *Candida* peritonitis occurred in 13 patients. Other fungal infections were much rarer, with only four cases of *Aspergillus* peritonitis identified, all of which proved fatal. The presence of diffuse peritonitis carried a poor prognosis, with approximately a 75% mortality rate in these patients.

Spontaneous Complications

Gastrointestinal Hemorrhage

Gastrointestinal hemorrhage of a mild to moderate severity was a frequent event in the postoperative course of these patients, but only significant bleeding (those requiring transfer to the intensive care unit or multiple blood transfusion) will be discussed here. Viral enteritis was a relatively common cause of severe upper gastrointestinal hemorrhage. Two patients had severe herpes esophagitis, two had herpes gastritis, and three patients had CMV gastritis as the cause of the bleeds. One of the patients with herpes gastritis eventually underwent a total gastrectomy for massive hemorrhagic gastritis when bleeding failed to stop after vagotomy and pyloroplasty and oversewing of bleeding points. This patient eventually died of overwhelming sepsis. Four patients required vagotomy, pyloroplasty, and oversewing of the ulcer for bleeding gastric (two cases) or duodenal ulcers (two cases). One patient bled from severe duodenitis, but eventually stopped bleeding after multiple transfusions.

Five patients required sclerotherapy for bleeding esophageal varices in the early postoperative period. Four of the five stopped bleeding with only one episode of sclerotherapy, but the fifth, who has a known 90% stenosis of the portal vein, has had multiple bleeding episodes. The sudden onset of variceal bleeding in patients who have undergone liver transplantation should prompt a thorough investigation of the status of the portal vein.

Lower gastrointestinal bleeding was less common and occurred to a significant degree in only six patients. In three the bleeding eventually ceased without an operation. Of the other three, one underwent a left hemicolectomy and bleeding ceased (no site was identified at pathology examination) and the second had massive bleeding from a torn hemorrhoidal vein, which was eventually controlled with packing (although he underwent a negative exploratory laparotomy). The third patient had

severe CMV-induced colitis and underwent a subtotal colectomy that stopped the bleeding.

Perforations

Spontaneous bowel perforations occurred in nine patients (4%). In six patients the colon was the site of the perforation: three cecal perforations, one cecal and left colon perforation, one cecal and small bowel perforation, and one left colon and small bowel perforation. Three other patients had small bowel perforations, with all cases involving the terminal ileum and in two of these patients also involving multiple additional sites within the small bowel. All perforations were treated with resection of the involved segments, with the decision about primary anastomosis made on an individual basis. There was no obvious cause for any the perforations. However, three cases involved patients who required mobilization of dense intra-abdominal adhesions, and unrecognized injury to the bowel at the time of mobilization of the intestines may have been responsible for these perforations.

Pancreatitis

Severe pancreatitis occurred in five patients, in two after apparently routine operations, in two after endoscopic retrograde cholangiopancreatography (ERCP) for evaluation of the biliary reconstruction, and in one patient who had multiple complications after transplantation. A pancreatic abscess developed in this patient and required a distal pancreatic resection. A pancreatic abscess also developed in one of the patients who underwent ERCP, and this patient eventually died of sepsis. One patient who underwent a retransplantation for rejection developed both a pancreatic pseudocyst and chronic pancreatitis, and required both a gastrojejunostomy for gastric outlet obstruction and a Puestow procedure for chronic pancreatitis.

Obstruction

Small bowel obstruction occurred in eight patients. In four cases it was secondary to adhesions, and in two the obstruction was the result of torsion of a loop of bowel around the Roux-Y limb. Two other patients developed small bowel obstruction secondary to lymphomatous involvement of the distal small bowel, and these two patients will be discussed more extensively later. No patient responded to conservative therapy and all underwent laparotomy. Only the two patients with lymphoma required bowel resections. The only case

of large bowel obstruction was secondary to massive fecal impaction and eventually responded to conservative efforts.

Wound Complications

Wound complications occurred in 25 patients (11.1%). These included infections, hematomas, and dehiscence. Staphylococcal species, gram-negative bacteria, and *Candida* were the three most common infectious agents. The rate of wound complications might have been higher without the liberal use of delayed primary closure in patients considered to be at high risk for wound infection (such as those undergoing retransplantation), and the aggressive opening of wounds that have excessive drainage. Five patients were returned to the operating room for closure of a dehiscence, but no patient had an evisceration.

Miscellaneous

Other gastrointestinal complications included: six patients who required splenectomy either as the result of intraoperative injury or septic complications involving the spleen; three patients who were incapacitated by severe herpes esophagitis (requiring hyperalimentation in two cases); one patient who died of massive thrombosis of all intra-abdominal veins after liver transplantation for Budd-Chiari syndrome; and one patient who underwent an exploratory laparotomy for suspected acute appendicitis (the appendix was normal and no cause for the patient's pain was identified).

RENAL COMPLICATIONS

Some degree of renal dysfunction was common in these patients. For the purposes of this study, renal failure was defined as an elevation in the creatinine to a level of greater than 2.2 mg/dl and that persisted at this level for at least 48 hours. By this definition, renal failure was present in 70 patients (31.1%), of whom 26 (37.1%) required dialysis. This is not surprising in view of the multitude of potentially nephrotoxic factors that these patients face. Many patients have some degree of renal dysfunction before the transplant (often as part of the hepatorenal syndrome), whereas others may develop renal failure or have a worsening of renal function as a result of any of the following factors: hypotension or massive blood loss during the operative procedure itself, the need for multiple operations, the onset of sepsis, or the use of

nephrotoxic drugs. These potentially nephrotoxic drugs include cyclosporine and the variety of antibiotics used to combat sepsis in these patients, especially the aminoglycosides and amphotericin. Cyclosporine, which is the primary immunosuppressive agent utilized in this series of patients, is profoundly nephrotoxic and may produce permanent renal injury.

Of the 26 patients who required dialysis, 19 (73%) died. Other renal complications included three right nephrectomies for intraoperative injury and three patients who had difficulty voiding and required long-term bladder catheterization and complete urologic evaluation. No patient required a urologic procedure.

NEUROLOGIC COMPLICATIONS

The neurologic complication seen most frequently was seizures, which occurred in 23 patients (10%). More than 50% of these seizures occurred in patients within the first 4 days after operation, the majority occurring within the first 24 hours. Their cause remains unknown. Patients had normal head CT scans and normal lumbar punctures. More than 90% of these patients had a single episode of seizures and recovered without a neurologic deficit. All the patients who had more than one seizure eventually had their seizures controlled with medications, and no patient had permanent neurologic injury. Phenobarbital, which was used to treat these seizures, enhances the metabolism of cyclosporine; careful monitoring of cyclosporine levels is essential in patients receiving phenobarbital. In the remaining patients the onset of seizures was often part of the terminal sequence of events in patients dying of multiorgan failure after liver transplantation. These seizures were often difficult to control and rarely was any cause for the seizures identified before death.

Seven patients died of massive intracranial bleeding. Three patients had smaller intracerebral hemorrhages; all three recovered with minimal neurologic deficit. Six patients developed meningitis. One patient developed *Listeria* meningitis and systemic *Listeria* sepsis and eventually died after a prolonged course. Two patients had cryptococcal meningitis and recovered. Three patients developed viral meningitis and all recovered completely.

Many patients are somewhat confused in the early postoperative period. If the hepatic allograft functions properly, this mild confusion clears rapidly. However, two patients experienced frank psychosis in the early postoperative period. Both

eventually recovered without residual neurologic problems. Three patients developed profound depression in the post-transplantation period despite rapidly improving hepatic function. One of these patients required electroconvulsive therapy. All three eventually recovered. Antidepressant medications must be used with caution in patients on cyclosporine because a number of these medications can affect either the metabolism or the absorption of cyclosporine.

Two patients had brachial plexus injuries during the operative procedure. These probably occurred during the placement of the axillary limb of the veno-venous bypass system. Both had significant neurologic deficit in the early postoperative period, but fortunately both have had marked improvement in the function of the upper extremity with intensive physical therapy. In the early experiences, three patients had peroneal nerve injuries secondary to pressure on the peroneal nerve during the operative procedure. Proper positioning and padding of the patient before the operative procedure should virtually eliminate this complication.

CARDIAC COMPLICATIONS

Refinements in the intraoperative and postoperative monitoring of patients undergoing liver transplantation has markedly reduced the incidence of serious cardiovascular complications. Hypertension is almost always present to some degree in all patients undergoing a successful liver transplantation. In the early postoperative period hypertension is treated with boluses of intravenous medications (usually 5 to 10 mg of hydralazine given as needed). Sustained, refractory hypertension, however, requires the use of sodium nitroprusside by continuous infusion. Once the patient resumes oral intake, oral antihypertensive agents are instituted, allowing for the withdrawal of intravenous medications. It is quite common for patients to require up to three antihypertensive medications and a diuretic for adequate blood pressure control. Often, the hypertension will become less severe after the first postoperative month.

With the exception of the high incidence of hypertension, other serious cardiovascular complications were rare, occurring in only 12 patients (5.3%). Six patients had severe arrhythmias: two died as a direct result of the arrhythmia, two required transvenous pacemaker placement for control of the bradyarrhythmia (one recovered and one died), and two patients recovered with medical therapy of the arrhythmia alone. Three patients had acute myocardial infarctions in the perioperative

period and two of the three died. Three patients were found at autopsy to have severe endocarditis. One had *Staphylococcus aureus* endocarditis of both the mitral and aortic valves and two patients had both myocardial abscesses and endocarditis, one with *Candida* and the other with *Aspergillus*.

OTHER COMPLICATIONS

Infection

A variety of infectious processes other than those already discussed also affected these patients. Foremost among these were other viral infections. Cutaneous, oral, and genital herpes simplex infections occurred in 25 patients (11.1%), which were rarely more than minor. Two patients developed painful herpes zoster infections and a third patient died of overwhelming herpes zoster sepsis. All patients with confirmed herpes infections received at least a 10-day course of intravenous acyclovir. CMV infections were also frequent; however, clinically significant infections occurred in less than 3% of patients. Three patients died as the result of complications of overwhelming CMV infections.

In any patient in whom there was a question of a significant viral infection, such as those who were febrile with a rapidly decreasing white blood cell count or who experienced increasing liver enzyme levels and were found to have viral hepatitis, the cornerstone of therapy was a drastic reduction in the level of immunosuppressive therapy. Close monitoring of the individual patient's clinical course during the viral infection allowed for the selection of the appropriate time for reinstatement of immunosuppressive therapy once the infectious process appeared to be resolving.

Another infectious complication that required reduction in immunosuppressive therapy occurred in a patient who developed disseminated atypical tuberculosis after liver transplantation. The patient developed multiple draining lymph nodes in the neck and also had massive involvement of the distal small bowel. The judicious use of triple drug anti-tuberculous therapy coupled with a drastic reduction in immunosuppressive therapy allowed the patient to make a complete recovery. The patient remains well with normal liver function and has tolerated reinstatement of the immunosuppressive therapy.

Hematologic Malignancies

The occurrence of a lymphoma in the transplant patient is another complication that requires a

reduction in immunosuppressive therapy. In this series five patients developed lymphomas, two of whom died. However, in neither case was the lymphoma a major contributing factor in the patient's death. One patient developed the lymphoma in the cervical nodes and the right kidney. After a right nephrectomy, the patient did well until rejection of the transplanted liver occurred and the patient died during attempted retransplantation. At autopsy, microscopic residual lymphoma was found in a few abdominal lymph nodes. The other patient died of *Pneumocystis pneumonia* and *Candida* sepsis and was found to have widely disseminated lymphoma at autopsy. In two other patients the presenting symptom was small bowel obstruction secondary to lymphomatous involvement of the small bowel. Both required bowel resection, recovered, and are presently doing well without evidence of residual disease. The final patient presented with acute pharyngitis and rapidly developed airway obstruction necessitating a tracheostomy. A tonsilectomy was performed and the diagnosis of the lymphoma confirmed. The patient made a rapid recovery and is presently doing well. All three of these patients had their cyclosporine doses reduced as soon as the diagnosis of a lymphoma was confirmed, and all presently appear to be cured of their disease. However, they continue to be closely monitored for any signs of recurrent lymphoma, for immunosuppressive therapy has been reintroduced in all three patients. Cyclosporine levels are closely monitored and are deliberately maintained at relatively low levels.

Another patient developed Hodgkin's disease 6 months after liver transplantation. The disease was present in groin and paraortic lymph nodes and did not regress with a decrease in immunosuppression. The patient has completed a full course of combined chemotherapy and radiation therapy complicated by chronic rejection of the transplanted liver. He is presently awaiting a retransplantation.

Miscellaneous

Severe thrombophlebitis developed in six patients and required surgical excision of the infected vein in three cases. In one patient the entire venous system from the basilic vein to the subclavian vein required excision. This patient died of multiple complications, including staphylococcal sepsis from the phlebitis. Staphylococcal species were also responsible for the other five infections in this group of patients. No other patient with phlebitis died.

Other rare complications are listed in Table 1. Surprisingly, decubitus ulcers were infrequent in

TABLE 1. Uncommon Extrahepatic Complications of Liver Transplantation

<i>Complication</i>	<i>No. Patients</i>
Decubitus ulcer	7
Infected seroma	
Axillary	3
Groin	4
Multiple vertebral fractures (all were patients with primary biliary cirrhosis)	4
Tooth abscess	3
Severe pharyngitis	2
Pseudomembranous colitis	2
New-onset asthma	2
Massive hepatic necrosis secondary to idiosyncratic reaction to colchicine	1
Knotted Swan-Ganz catheter requiring surgical excision	1
Respiratory arrest after monoclonal antibody therapy	1

these patients, with only five patients developing significant decubiti. This attests to the fine nursing care given these very ill patients. Also, the use of the Clinitron bed for selected patients has proved beneficial in preventing decubitus ulcers. Once present, however, these ulcers proved difficult to heal in these immunosuppressed patients. No patient became overtly septic from a decubitus ulcer.

Complications related to the axillary or inguinal sites for the veno-venous bypass were usually minor, with significant complications occurring in only seven patients. These included three axillary seromas and four groin seromas that became secondarily infected; all responded to simply draining the seroma and packing the wound open.

Four patients with primary biliary cirrhosis had a collapse of one or more vertebral bodies after liver transplantation. No patient had a neurologic deficit, but this complication significantly slowed recovery and these patients required prolonged rehabilitation in the hospital.

Three patients developed dental abscesses and all underwent extraction of the offending tooth. No patient developed overt sepsis from a dental abscess, but all three patients had fever and malaise and required readmission to the hospital for antibiotic therapy as well as extraction of the tooth. Three patients had fractured hips in falls during the recovery period. Two of the three recovered after successful surgical repair of the fracture. However, one patient died of sepsis associated with a pneumonia that began during the hospitalization for the fractured hip. As was the case with the patients who had vertebral collapse, the two surviving patients required prolonged periods of rehabilitation.

Two patients required readmission to the hospital for severe pharyngitis. In both cases the cultures were negative and the cause of the pharyngitis was felt to be viral. Both patients were carefully observed for airway obstruction or the possible development of lymphoma. Both recovered without sequelae.

Pseudomembraneous colitis developed in two patients. Both had severe diarrhea with dehydration but, after confirmation of the diagnosis, both recovered rapidly following the introduction of oral vancomycin therapy.

Severe asthma developed in two patients during the postoperative period, and both patients required transfer to the intensive care unit for intravenous aminophylline therapy. Neither patient had a prior history of asthmatic attacks. No etiologic agent was identified in either case and both patients required maintenance theophylline therapy.

One patient died of massive hepatic necrosis due to an idiosyncratic reaction to colchicine and another patient required a venotomy in the internal jugular vein to remove a knotted Swan-Ganz catheter. Finally, one patient had a respiratory arrest

after receiving a dose of monoclonal antibody. The patient required mechanical ventilation for 6 hours but recovered fully.

SUMMARY

The massive surgical assault associated with hepatic transplantation makes a high frequency of complications almost inevitable. In this review of 225 patient records, selected at random from cases of liver transplantation in Pittsburgh over a 2½ year period ending in January 1985, 87.2% of patients experienced at least one significant complication that threatened their survival or that of the graft and that often prolonged their hospitalization. Familiarity with the complications may facilitate earlier recognition, with consequently early and more effective management in future cases.

Acknowledgment. Supported by Research Grants from the Veterans Administration and Project Grant No. AM-29961 from the National Institutes of Health, Bethesda, Maryland.