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Discussion

Dr. F. William Blaisdell (Sacramento, California): Many of the principles that Drs. Pachter and Spencer outlined in the management of liver trauma are appropriate and will lead to lower morbidity and mortality. I particularly agree with the appropriateness of definitive direct ligature of the bleeding point.

I would like to take issue with a couple of their facts and say that they are, perhaps, fallacies. The first of these relates to the fact that hepatic venous injury is a common result of liver laceration and is a frequent source of hemorrhage. In my opinion it is a relatively rare cause of persistent hemorrhage.

Hepatic venous injury occurs most often in association with high velocity, blunt trauma. Bleeding from hepatic veins is usually from the undersurface of the liver, and under these circumstances the use of an internal shunt has provided a means of temporary control of bleeding. When the hepatic venous injury is in the depths of a laceration, bleeding usually stops spontaneously. This is because along with portal injuries this is low pressure bleeding and generally is tamponaded by the liver. Major, open lacerations can be a serious problem. Attempts to control stab wounds or gunshot wounds by further opening the laceration results in the potential of devascularization of major segments of the liver and for more ultimate morbidity.

Another issue I take with the authors' "facts" relates to hepatic artery ligation. I have little question that hepatic artery ligation has been a major advance in the management of certain types of liver injury, particularly penetrating types of trauma in which disruption of the substance of the liver is minimal. Under these circumstances portal venous injury and hepatic venous injury are readily tamponaded and are not clinical problems. The primary bleeding problem relates to hepatic artery injury, and this is the reason that hepatic artery ligation works. We have reported a series that confirms the observation of Dr. Truman Mays that it is a safe procedure. We have had no mortality with the selective use of hepatic artery ligation, and it is a much simpler procedure than hepatic resection.

Certainly if the bleeding persists after the portal triad clamp has been applied usually it is due to hepatic venous bleeding. In some instances, however, abnormal supply of the left lobe of the liver by anomalous branches of the hepatic artery are the source of hemorrhage, and one should look for these should hemorrhage not be controlled by the application of the clamp. If the bleeding persists, and the hepatic arteries are controlled, then a procedure to isolate the hepatic vein is indicated. However, coming down on the hepatic vein through the laceration is like looking directly into the vena cava; this can be difficult and associated with massive loss of blood.

The principles outlined of good drainage, the application of the omental pack are something that all of us can apply and improve upon our results in the management of liver trauma.

Dr. Ben Eiseman (Denver, Colorado): Drs. Pachter and Spencer have identified important principles in the management of liver injuries and have shown that by a straightforward method of gaining exposure of deep injuries in the parenchyma they can achieve an excellent chance of survival by simple suture of the major vascular bleeding points.

At the Denver General Hospital, Dr. Aragon and I reviewed 300 consecutive liver injuries and more recently Dr. Eugene Moore reviewed 273 more. We recognize three main types of injuries. The first category, making up 85% of the cases, are simple superficial lacerations in which there is almost no mortality from the liver injury itself.

The second category, making up about 10% of the injuries, is deep lacerations into the parenchyma, and it is with these that Dr. Pachter is largely dealing in his paper. He states that bleeding was controlled in 21 of 22 of his injuries by cross clamping the porta hepatis. This is how to differentiate a serious deep Class II injury from the far more dangerous Class III injuries that are into the vena cava and into the hepatic veins as they converge into the cava. The Pringle maneuver does not usually even slow down bleeding from these rare (±5%) but grave injuries. We agree with Drs. Pachter and Spencer that you have to get to them quickly through the chest.

The message of this carefully detailed experience is to expose the bottom of deep liver injuries and accurately ligate the bleeding point. The authors have shown us that, if the site of bleeding cannot be seen, the overlying liver wound should be extended by finger fracture to expose the vessel deep in the liver substance. The technique is simple, direct, sound and well documented, as is typical of the work of authors of this paper.

Dr. Alexander J. Walt (Detroit): I believe that the liver has been given excessive attention in recent years but at least our perspectives on liver injury are much improved and clearer. By and large, injury to the liver tends to be relatively innocuous, as 50% of patients will have stopped bleeding by the time we operate on them and almost another 40% require little more than some sutures or hemoclips. It is the remaining 10% of patients that we are bothered about.

I would point out as a matter of historical interest that Mr. Pringle, when he reported his maneuver in 1908, presented eight cases. He had gone to the surgical laboratories in Vienna and worked on a lot of rabbits—presumably, they did not have rabbits in Scotland at that time—came back and operated on eight patients; they all died. So the mortality was 100% for those on whom he tried his maneuver. Even today, however, the Pringle maneuver is not effective in a fair number of instances of massive liver injuries. Dr. Blaisdell has given some reasons for this, not the least of which is the occasional anomalous blood supply to the liver such as a branch of the left gastric supplying the left lobe.

What we really need in liver injuries is an injury severity score if we are to assess our results accurately. Indeed, I believe that we need a reliable injury severity score for all trauma as we currently tend to match apples and oranges. If we were to have such an index for liver injuries, four main things would need to be looked at. The first is the patient—and our patients in Detroit often tend to be drugged, drunk or debilitated, which works against their recovery. Second, we must look at the nature of liver lesions carefully as they obviously vary a great deal in different environments. Third,

one needs to consider the variety of associated lesions outside the peritoneal cavity whether these involve the brain, the chest or other organs. Last, the occurrence of associated organ injuries within the peritoneal cavity, more particularly concomitant vascular and colonic injuries, are of vital importance. For example, if the colon is injured, sepsis is much more likely to supervene and to increase the mortality.

I remain uncertain, as apparently is Ben Eiseman, about the degree of injury in these patients. To salvage 21 of 22 severe injuries is something of a surprise if only because of the usual association of colonic and vascular injuries in these patients which are liable to carry the patients off rather than the liver injury.

As you so successfully stemmed the bleeding, I would ask if you used Avitene on any of your patients and cannot help noting with interest how seldom you had occasion to ligate the hepatic artery.

I would like to know whether you really believe that all liver injuries must be drained because Dr. John Perry has shown us that this is possibly unnecessary.

DR. RONALD A. MALT (Boston, Massachusetts): Ligation of the hepatic artery is often useful and sometimes indispensable but not without hazard. Hepatic necrosis and other difficulties can occur. If, in exchange, bleeding is controlled in most patients, it is a satisfactory exchange. However, the really deep and the bad liver injuries are those in which hepatic artery ligation probably will not work, for reasons just described.

I, too, believe that injuries of the vena cava and of the major hepatic veins are unrecognized and poorly treated causes of uncontrolled hepatic hemorrhage. This is often the situation in which the liver does not really look too bad, but there is abundant blood coming from somewhere. When that situation occurs, and you are sucking and sucking without being able to identify the source, the place to look is behind the liver, in the cava.

Although I have used intracaval shunts with some success and with some enthusiasm in years gone by, I have turned to using them now only *in extremis*. The reason is that a maneuver of simply freeing the right lobe of the liver by division of the triangular and the coronary ligaments to permit the right lobe of the liver to be totally freed and rotated all the way to the left puts torsion on the inferior vena cava, and often the hepatic veins, so that bleeding —if it does not stop—at least slows enough so that one sucker can be used instead of three. Torsion also permits apposition of the cut edges of the vena cava and hepatic veins with Judd-Allis clamps so that caval integrity can be restored to allow restoration of blood flow; it also permits judicious and careful approximation of the tissues with 4-0 vascular sutures at a time of one's choice.

I have not been enthusiastic about packing the liver with anything except when all other measures to stop bleeding fail. Although it is true that authorities describe leaving the liver open and not draining it, I believe it is a better pedagogical principle to leave the liver open and to remove the efflux of blood and bile. If it is a shallow injury, no omental packing is required, and therefore packing is a useless step. If the injury is severe and deep, I am concerned that the "occasional" hepatic surgeon will be tempted to fill that great gap with omentum, leaving a devitalized liver lobe behind, when he should follow the other, more difficult, principle that Drs. Pachter and Spencer described: namely, immediate resectional debridement. Either that, or he should pack the wound with gauze to allow transfer to a center for hepatic surgery. Clearly, the excellent results of Drs. Pachter and Spencer are going to be a standard for comparison.

DR. FRANK C. SPENCER (New York, New York): Dr. Pachter's modesty makes it difficult to recognize the scientific importance of these data. The principal reason that the results are so good is that Dr. Pachter was personally present in the operating room for 84 of the 85 operations reported. The one operation performed when he was out of town was when the hepatic artery was ligated. Our results with the 22 massive injuries described (one death and one abscess) are so dramatically different from our previous experiences that we reported them at this time. The series of course is small, so ultimate conclusions will depend upon future experiences of others.

Regarding ligation of the hepatic artery, we have no data to discuss, and can only state that the basic concept seems of dubious validity.

Concerning massive lacerations which involve the vena cava, the experiences of others would seem to indicate that the only hope of salvage is by quickly opening the chest and inserting an intracaval shunt. To date, this has been necessary in one of the 22 massive injuries in this series. The important hypothesis to be evaluated with future experiences is that a decision of whether or not to open the chest can be made fairly soon after compressing the portal triad. Unless hemorrhage is promptly controlled by temporary compression of the portal triad, the chest should probably be opened. The high mortality with intracaval shunts may be partly related to delaying opening the chest until a coagulatory has resulted from loss of 10–20 units of blood.

To repeat, the experiences described by Dr. Pachter are so dramatically different from our previous experiences at Bellevue Hospital over the past seven to eight years that I personally am convinced that they are highly significant. Only time and further data can confirm this.

DR. H. LEON PACHTER (Closing discussion): We agree with Dr. Blaisdell that, certainly, for injuries to the retrohepatic cava that are actively bleeding, the Pringle maneuver is not adequate, and an intracaval shunt is needed.

In terms of the injuries that we were dealing with we initially used bimanual compression of the liver when we let go, there was continued bleeding, and certainly something else needed to be done. When I was a junior resident, some of these that initially stopped had to be taken back a day or two later for massive bleeding, as the clot probably had come off the vessel.

Dr. Spencer mentioned that hepatic artery ligation was only done once, when I was out of town, and that patient died of hepatic necrosis and an intrahepatic abscess. Again, I have not performed this procedure, and I am not sure of the rationale for it.

I would like to thank Dr. Eiseman for his kind remarks and also agree with the need for an intracaval shunt in retrohepatic caval injuries.

I would like to thank Dr. Walt for his enlightening talk. No, we have not used Avitene. I do not think Avitene will control bleeding from large vessels, but it may have a role for minor venous oozing from the hepatic parenchyma. I also agree about the hepatic artery ligation.

As for drainage, we do drain. I know of Dr. John Perry's results with not draining liver injuries, but before I stop draining liver injuries, I would like to see the results of a randomized prospective study.

I would also like to thank Dr. Malt for his kind comments and agree that hepatic artery ligation may be a trade-off—abscess for control of bleeding. Hepatic artery ligation has been shown to be safe in the elective situation, but when hepatocytes have sustained a significant period of anoxia, and one superimposes hepatic artery ligation, there is probably an increased incidence of intrahepatic abscess.

I think the maneuver that Dr. Malt mentioned of rotating the liver is a good one, and I am certain that it can temporarily control bleeding from the retrohepatic cava or the hepatic veins.

Again, I would like to stress the importance of resectional debridement and would also mention that resectional debridement should not be misconstrued as a hepatic resection.