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Discussion

DR. KENNETH W. SHARP (Nashville, Tennessee): Thank you, Dr. McDonald. I appreciate Dr. Fabian and Dr. Croce giving me a copy of the paper ahead of time. This is a very nice presentation of a very anxiety-provoking group of patients. This is a lot of work and a lot of stress. It's very stressful observing patients who have a grade III, IV, or V liver injury on CT-scan.

In the interest of time, I will get straight to my questions. Several points made in the manuscript that were not brought out in the presentation, I thought, were very interesting. Liver-related failures occurred in 20% of your Grade I liver injuries. I assume that is only one patient out of five, but I am fascinated that somebody with a Grade I liver injury would fail nonoperative management. Can you tell us why that patient failed, and could that be predicted?

Secondly, can you answer your question about prediction of patients who will fail? In the manuscript, you pointed out that there are four or five patients who were explored 36 to 48 hours after the injury because their CT scan showed increasing hemoperitoneum but indeed these patients were stable. They were explored and, I believe, nontherapeutic laparotomies were done.

Are these patients failures? Would you now do the same in your next group of 100 patients?

Thirdly, I agree with the recommendation to observe these patients in the intensive care unit. That seems intuitive to me, but I don't know how long you need to observe these patients in the intensive care unit. Until they are "stable?" One day, 2 days, 4 days? One patient that disturbed me a lot in your manuscript was a patient who on day 11 became hemodynamically unstable when they ruptured their liver or a pseudoaneurysm—I'm not sure which. How long do you monitor these patients in the intensive care unit, as this will become a cost factor for you in the future?

I appreciate the opportunity to review the manuscript and to make these comments.

DR. DAVID V. FELICIANO (Atlanta, Georgia): Good morning. It's a pleasure to discuss a prospective study in this area, as it fills in so many of the gaps in our knowledge. Slowly but surely we have all come to recognize that hemodynamic stability and not the CT appearance of the liver will determine which patient should be considered for observation.

I have three questions for Dr. Croce. First, if you go back and review the original CT scans of the five liver-related failures in the study group, is there any evidence of ongoing hemorrhage or any hint that these patients would fail? Was there excessive pelvic blood that, in retrospect, might have been an indication for hepatic arteriography and embolization?

Secondly, if you take the group at highest risk for failure, that is, those with an admission blood pressure under 105 mm of mercury, would it not be more cost effective to perform early hepatic arteriography rather than watchful waiting for 1 or 2 weeks in the hospital?

And, finally, the problem or the question that is asked by community surgeons around the country when they have to deal with this, is what do you do if your CT scan at 5 days after injury shows absolutely no improvement, or even worsening, but the patient remains stable?

I enjoyed this excellent presentation. I thank the authors for a copy of the manuscript, and the Southern for the privilege of the floor.

DR. J. DAVID RICHARDSON (Louisville, Kentucky): Several of my comments and questions have already been made. I think this is an excellent paper. And, I think, as Wayne Meredith and others of this Association have shown, there is no doubt that we can do nonoperative treatment and do it safely in most patients.

It seems to me that the value of nonoperative treatment is not in saving blood or money or anything else, because I'm not sure that this study really showed that, at least to my satisfaction. I think the real value is in potentially saving lives from the avoidance of meddling—as Tim referred to it, "don't poke the skunk." And I certainly remember very vividly a young woman a few years ago who was completely stable, that I operated on, and we ended up in a situation where it just took one look, and that was all it took.

And she developed torrential bleeding which eventuated in liver packing and subsequent death from sepsis. I have encountered a few other cases where I thought we did not do the patient

any good and, perhaps, did harm, although the outcome was probably never that bad.

I did have a comment or a question about the transfusion requirements. Is the total of 1.3 units per patient the actual number of total blood required? If that is the total transfusion requirement, it doesn't seem like an awful lot for a group of seriously injured patients, particularly if they have polytrauma with pelvic fractures and femur fractures and the like—because there was something in the manuscript talking about femur fractures and other things. So were those the actual units of transfusion?

Then you mentioned in the manuscript that those were the 48-hour transfusions. And if that is the case, what were the total requirements? Were there patients that needed to sort of have their tank topped off, if you will, in order to get them out of the hospital?

I think the most important concept, it seems to me, is what Ken Sharp referred to, and that has to do with your mindset or the intent to treat? Is your intent to operate if things get a little shaky? Or is it your intent to keep watching?

What happens to us, I think, is that we usually blink when we get to about 4 or 5 units and go ahead and operate, even if we think there are other reasons to account for that blood loss. And I'd be curious as to how you make those decisions.

I think it is an excellent study and commend it to everyone's attention. Thank you.

DR. MARK A. MALANGONI (Cleveland, Ohio): Thank you. This is a prospective investigation of patients with hepatic injury who are managed by experienced trauma surgeons in a dedicated intensive care unit with 24-hour resident coverage.

Their stated goals were to assess the safety of this practice and to identify factors predictive of which patients could be successfully managed without operation.

Nonoperative management was associated with fewer blood transfusions; however, assuming the current rates of transfusion-related disease transmission in the authors' experience, approximately 14,300 patients must be managed nonoperatively in order to avoid one transfusion-related death.

In contrast, assuming a 15% mortality rate from intra-abdominal abscess, they avoided one death from intra-abdominal infection in the 112 patients that they studied—which, although perhaps not statistically significant, I think we would all feel is important.

The authors were incorrect in their selection of the method of treatment in one of every eight patients. Despite a considerable effort, no parameters predictive of failure could be identified.

I have the following questions:

Although hemodynamic variables at admission were not predictive of failure, do you think that a change in hematocrit or vital signs within the first 6 to 12 hours of hospitalization would be predictive?

In the manuscript, you suggested radiologic testing—different radiologic testing or a revision of the liver injury scale is needed. Could you please give us more definitive recommendations?

Third, is an ICU stay needed for all patients? We currently do not admit patients who have isolated low-grade blunt hepatic

injury with minimal hemoperitoneum on CT scan to an intensive care unit.

Lastly, five patients in the observed group needed operation for a missed injury as late as 54 hours after admission, and three of these patients developed an intra-abdominal infection. Do you have any suggestions how to avoid this morbidity?

This report is a great step forward in defining safe, nonoperative management of liver injuries, but continuing evaluation and further refinements continue to be necessary.

Thank you very much.

DR. J. WAYNE MEREDITH (Winston-Salem, North Carolina): President McDonald, Secretary Copeland, Members, and Guests. I really enjoyed this paper, Dr. Fabian.

This concept is clearly correct, and it is clearly here to stay. There is a lot more definition that needs to be done. Our data of about 100 patients like this saw almost exactly the same failure rate. We can predict failure by their initial hemodynamic stability and that, I think, was done based on better defining and better graduating the levels of hemodynamic stability when patient presents.

It is also a phenomenon of the era of CAT scanning. In another study than the one I just referred to, we did CAT scans and diagnostic peritoneal lavage of 100 patients. Thirty percent of the patients with liver injuries diagnosed by CAT scans had negative diagnostic peritoneal lavage. Some of these are patients that have a newly discovered disease that has never been significant, we have never treated them before, and it is just a phenomena of CAT scanning.

I have a few questions that I am interested in the others have not asked about. I would like you to expand on your management protocol. When do they get out of the unit? When can they get out of bed? When do they get to go home?

Do you continue to do these frequent follow-up CAT scans? I have been through that stage of this and have discovered that we do not do anything for any CAT scan that is ordered on a routine basis; only if the patient needs a CAT scan because of abdominal pain, because of vomiting blood, because they have fever.

And the last caveat I would like to mention is this “don't poke a skunk” concept. You know, you see a CAT scan showing a liver laceration that extends down into the intrahepatic vena cava and a little pump of blood coming out of the hepatic vein, you think, “Boy it would be nice to not operate on this patient.” I think that philosophy is hazardous. We should not be afraid to operate on these patients because we know that it is sometimes possible not to. Instead, we should learn from the fact that if this patient can survive without an operation, then we ought to be able to design an operation which that patient could survive.

I think the point is exactly the opposite of what people are trying to take now. Once again, I thank the Association for the privilege of membership, and I very much enjoyed this paper.

DR. MARTIN A. CROCE (Closing Discussion): Thank you, Dr. McDonald, Dr. Copeland, Members, and Guests. I'd like to thank all the discussants for their very kind comments, and I will try to address them as briefly as possible.

First, Dr. Sharp asked about the liver-related failures. Yes, we did have one failure with a grade I injury. As we have demonstrated in a previous study from our institution, the CT grading actually does not really correlate all that well with operative grading and, in fact, this patient was misgraded. On CT, the patient had what appeared to be a grade I injury, in actuality there was a grade III injury. That patient was taken to the operating room and had omental packing of the wound.

Relative to the prediction of the liver-related failures, there was one patient—in fact, one patient in the entire series—who just had worsening of CT on routine follow-up. That patient did not have nontherapeutic laparotomy—in fact, was taken to the operating room and had omental packing, despite the fact that she was hemodynamically stable. This occurred early on in the study. Since that time, we have been fortunate enough not to have another patient who has had a worsening CT scan.

What would we do if that were the case? I think as long as the patient remained hemodynamically stable and there were no ongoing transfusion requirements, then I think currently we would continue to observe that patient.

Relative to the length of stay in the intensive care unit—and this also answers several discussants' questions—it's very difficult to evaluate length-of-stay data, especially on these patients with multiple injuries. In fact, of the population of patients managed nonoperatively, only 5% had isolated hepatic injuries. And that means 95% had associated injuries, most commonly, long-bone fractures.

It is our opinion that it takes a significant amount of force to cause a femur fracture in a previously young, healthy patient. Therefore, it is our routine to observe those patients in the trauma intensive care unit. So they continue to stay there until they reach hemodynamic stability.

How can we define that? It is defined primarily as stabilization of the hematocrit with no ongoing transfusion requirements, adequate urine output, and all the routine things.

Dr. Feliciano asked about review of the CT scans. Yes, we did review the CT scans of those patients who did have the liver-related failures, and really could not find anything that was predictive of that. Certainly, none of these patients, even in retrospect, had evidence of ongoing hemorrhage on their initial CT.

He also asked about early arteriography in patients who are considered to be high risk. I am not sure of the utility of that, since most of the bleeding that occurs after significant hepatic injury is venous bleeding, and that's why we are able to observe so many of these patients despite some of the most significant injuries that we have seen in the liver. So how useful would arteriogram be? I'm not really sure. Perhaps so in a very small percentage of patients.

Dr. Richardson asked about the transfusion requirements. Dr. Richardson, regardless of how we looked at transfusion requirements, still the nonoperatively managed group wound up with less blood. We analyzed the data relative to transfusions for the first 48 hours and also for the length of their entire intensive care unit stay. Regardless of how we looked at it, those

patients managed nonoperatively got significantly fewer units of blood.

In the patient with multiple-system injury who is relatively hemodynamically stable, yes, some of those patients do wind up getting some blood. How much we attribute to the liver and how much we attribute to associated injuries is somewhat difficult to determine objectively. We attribute several rough estimates of blood loss per injury. For example, a femur fracture is about 2 units, and then you add another unit of blood for an open fracture.

We think it is imperative that we account for all units transfused.

Dr. Malangoni asked about the change in hematocrit, could that perhaps be predictive? We analyzed hematocrits every 4 hours for several days. And despite that mountain of data, we really could not find anything. Relative to revision of the hepatic injury grade, I think that that is very important. There are several patients who had CT scans who had periportal tracking of blood, and blood just going along the vena cava, which by definition labeled them a grade V. Perhaps we need to re-evaluate this whole grading system relative to the new technology, since we now can see more liver injuries with the newer technology of CT scanning.

Relative to those patients who went to the operating room late, those patients primarily had retroperitoneal injuries. And if we could figure out a better way to diagnose retroperitoneal injuries quicker, then perhaps their morbidity would be less.

Dr. Meredith, I appreciate your comments. Relative to the management protocol, our management protocol was very similar to yours in your series. We got these patients out of bed as quickly as possible, as quickly as their general condition permitted, and they were permitted to return to full activity as soon as their liver either was near normal or normal on follow-up CT scan.

We had no patients who had evidence of active hemorrhage on CT and, in fact, I would imagine that patients who had evidence of active hemorrhage on CT, particularly from a retrohepatic vena cava, would not really be stable enough to go to the CT scan. Those would fit into the category of patients who underwent emergent exploration for hemodynamic instability.

One additional comment relative to your statement about getting routine CT scans. We have found that not only in the management of these liver patients, but also in the management of patients with splenic injuries that are managed nonoperatively, that they can develop pseudoaneurysms. We had two pseudoaneurysms develop in the liver and a number in the spleen groups. And we think that with early intervention and radiographic embolization that their outcome is certainly improved, as opposed to waiting until there is a large intrahepatic cavity that develops which would then necessitate a formal hepatic resection.

On behalf of the authors, we would like to thank the surgical residents of the University of Tennessee, Memphis, and the staff of the trauma intensive care unit at the Presley Trauma Center. For without these dedicated people, this study, as with most clinical trials, would not have been possible.

We'd also like to thank the Association for the honor of presenting these data, and I thank you for the privilege of the floor.