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Discussion

DR. J. DAVID RICHARDSON (Louisville, Kentucky): Drs. Nunn, Wells, Copeland, Members, and Guests. It is indeed a pleasure to discuss what I think will be a landmark paper.

Before this paper and the recent one from the AAST, I think the only paper that really sequentially looked at a large number of patients with CT followed by angiography was one that Dr. Frank Miller and I completed at the University of Louisville using conventional CT scanning. And in that methodology, we really found that conventional scanning was wanting.

I think the authors have shown with helical scanning, that that's an entirely different entity and that most likely this will replace angiography in many centers as the initial screening tool.

I do have a couple of questions about your methodology on the use of the helical CT. First, how does it work with branch injuries? Where do you see it being used in the evaluation of those patients? Do they need angiography, and how does that go?

The second question refers to the interaction of your radiologists. We are radiology deficient — particularly in the middle of the night — particularly with people who are experts on the CT scans, and I'm curious how much of this is a phenomena of having very interested CT radiologists. And, was your interpretation in that 100% sensitivity-dependent on having radiologists present, or was that more or less amateurs such as first-year residents and surgeons?

Third, we have been impressed that the things we see on angiography often under-call what we see at operation, and I wondered if you see that with the CT reconstruction?

Finally, a word of caution about the antihypertensive therapy. I think that's a very dangerous thing in the way it's being used around the country, where people are basically trying to convert this into an elective operation. I think that's occurring in many centers. I think we need to be careful with that. What are your comments about this?

Thank you. [Applause]

DR. LORING W. RUE, III (Birmingham, Alabama): Thank you, Dr. Nunn, Dr. Copeland, Members, and Guests. Two major questions have been addressed by Dr. Fabian and colleagues — first, the role of rapid high resolution helical CT in the diagnosis of blunt aortic injury — and second, the role of pharmacologic agents to reduce the risk of spontaneous rupture in patients with injury. Both are appealing to those of us in trauma surgery who routinely care for those patients.

Although aortography has been the diagnostic gold standard for years, it's invasive, expensive, time-and-resource intensive, and still subject to limitations of false positive studies. In many trauma centers in this country, abdominal CT is used routinely to evaluate patients, and confirmation of CT to evaluate the abnormal mediastinum would be heartily welcomed.

Now the authors' protocol in using helical CT has yielded at least similar sensitivity as aortogram and has enabled the reduction of the use of this more invasive technique to 33% among high-risk patients with commendable results.

Equally of interest is the pharmacologic regimen used to reduce aortic wall stress. The authors report no such patients with spontaneous rupture to be contrasted with the 12% instance in the recently reported AAST study.

Further, the ability to delay repair in these severely injured patients until they are globally improved is a definite plus.

My first question: patients with severe head injury, nearly 40% in your series, are one group of patients for whom you would advocate pharmacologic intervention and delayed repair. At many trauma centers a strategy is used of maintaining cerebral perfusion pressure, often though the use of vaso-active drugs is followed. Could you help us balance the double-edged sword of minimizing systemic blood pressure for the aorta while maximizing perfusion to the brain?

And in a related vein: half the deaths in the nonoperative group were from severe head injuries. Were these patients directed to nonoperative management from the outset, or did they migrate to that group due to death before planned delayed operation?

The manuscript indicates 20% required laparotomy with two-thirds undergoing abdominal surgery before aortic repair. Could you comment on the one-third who did not follow the conventional dogma of abdominal operation before thoracic? I ask this because some form of circulatory assist, perhaps using heparin, was typically employed in your repair.

Finally, could you comment on the learning curve for surgeons' interpretation of helical CT, as your manuscript suggests? Much like the use of abdominal CT, the surgeons' evaluation of the images is of paramount importance. Did 3-D reconstruction con-

tribute to diagnostic accuracy or to the frequency of indeterminate scans?

And for those of us who wish to follow your lead and evaluate our institutional skill, what was the frequency of renal dysfunction among patients receiving contrast boluses for both CT and aortogram?

I want to compliment Dr. Fabian and his associates for an excellent study. Clearly, this work will have major impact on trauma care in the future and has prompted a reevaluation of our approach to these patients at UAB. I'd like to thank the Association for the privilege of the floor. [Applause]

DR. MICHAEL L. HAWKINS (Augusta, Georgia): Drs. Nunn and Copeland and Guests, most of my questions have already been addressed. And let me just outline further, in answer partly to Dr. Richardson, I think the CT technician is critical in this thing. And once they know the protocol, even surgeons like myself can learn to read things, certainly the big ruptures.

Whether the diagnosis is made by aortography, helical scan, or TEE probably depends as much on the local resources, the time of day, and what day of the week it is, as it does upon which technique is better.

We have had some experience at MCG with the nonoperative or delayed operative management of known injuries, although I must admit not voluntarily on my part. And they worked out okay. But my concerns also reflect Dr. Rue's. How do you balance the needs of the cerebral perfusion pressure with the needs to keep the mean arterial pressure down low?

I do ask one question. The treatment of dissecting aneurysms with pharmacologic agents, which was based, my understanding is, on spontaneous dissections in hypertensive patients is not the same kind of injury as an 18-year-old car wreck victim that previously had a normal aortic tree and heart.

Thank you for the privilege of the floor. [Applause]

DR. TIMOTHY C. FABIAN, (Closing Discussion): I'd like to thank all the discussants for their questions. First, Dr. Richardson, relative to branch injuries, all the arch injuries, of course, involved the great vessels. However, there were four injuries off of the arch that were missed on the helical scan. However, these were all intimal type injuries without hematoma. Two of those were evident by other clinical examination, including evaluation of the blood pressure with subclavian injuries. And I don't believe those would have been indications for aortography other than the fact that they had clinical findings.

As far as our interaction with radiologists, I think this is an extremely critical point, and we are fortunate to have an interested and aggressive radiology group as far as imaging services. They make sure that we have good equipment and good technical support.

As far as the sensitivity, was that only because the "CT experts" read them? No, the vast majority of those were read in the middle of the night by surgeons and radiology residents at various levels. Essentially, all of the pseudoaneurysms can be picked up by even somebody like me. Admittedly, we did miss some of the intimal injuries, the slight intimal injuries that were picked up the next morning by our radiologist, but, once again, none of those ended up causing problems.

It was suggested that aortography, in fact, does occasionally underestimate injuries that you find when you get in the operating room are more extensive, and this would be nice to know to plan your operation better. I think CT in fact does delineate the morphology of the injury to a greater degree than angiography. Again, if you follow those axial scans up, you can see where the lesion stops and follow them down and see where it stops, certainly to a better degree than you can with aortography.

As far as delaying therapy, I hope that nobody takes these data as a rationale to work these cases into their elective schedule. That certainly isn't the intent. I think the only reason to delay is if they have significant associated injuries that would complicate their recovery if they underwent emergent surgery.

Dr. Rue and Dr. Hawkins addressed the issue of closed head injury and cerebral perfusion pressure. All of these patients who have GCS of 8 or less will have ICP monitoring placed. In those patients, we tried to maintain a cerebral perfusion pressure of 70. We will be a little more liberal with our antihypertensives than we would otherwise. This is a small group of patients.

Very importantly, relative to the way we delay surgery — and I think every institution needs to take this into consideration — is what is your operative management? We have relied heavily over the years on partial bypass because of issues related to distal aortic perfusion when you have to heparinize patients and they've got a little bit of blood in their head. Regardless of their Glasgow Coma Scale, that certainly is a threat. That has impacted somewhat on our delays. I think each individual institution would have to address that situation for itself.

As far as postrepair laparotomy, there were, I think, five cases that underwent laparotomy after aortic injury repair. These were patients with significant liver or spleen injuries that weren't bleeding preoperatively or when we opened them up.

Are 3-D reconstructions helpful? When we first started this 4 years ago, I was extremely impressed with nice pictures like I showed you today. As the years have gone by, it's clear to me that they're nice gingerbread but they're not really very essential. These are reconstructions of actual images and, in fact, you lose a little bit of definition with reconstruction. And if you'd just look at your actual images and, once again, figure it's 3.5 mm you can get a pretty good idea what's going on. But we as surgeons need to start thinking in that line rather than normal aortography reconstruction. So, yeah, they're pretty and they make a nice presentation, but they are not really that important.

Renal dysfunction, yes, we give 300cc of dye if we do both aortography and this. But I think we have cut our aortography down dramatically and we haven't really noticed that to be a source of renal dysfunction. Although in these multiple-injury patients, as you are aware, it can be pretty difficult to tell what's going on as far as a bump in creatinine.

Mike had suggested that we are applying this logic perhaps in a contorted way between dissecting aneurysms *versus* blunt aortic injury. This concept really was started in 1981 by the group at Massachusetts General Hospital with blunt aortic injury, and their rationale was, gee, let's decrease sheer forces like we do in dissecting aneurysms. I agree it's a different pathology, but I would submit to you that the results speak for themselves. And if we have had 70 cases, regardless if it's a different disease, it seems to work here. And, I think other people should look at this. I'm very confident these data are effective in preventing rupture.

Thank you very much. [Applause]