DR. GARY ROUBIN: I would like to invite the panel up now for our discussion. There are some very interesting issues that have been raised here. Please start things off.

DR. PATRICIA THORPE: I guess I'll address this question to Dr. Theron or Dr. Ferguson, but it seems like there is a lot of intravascular spasm associated with acute ischemia. Is there a role for intravascular inter-arterial vasodilators such as nitroglycerine when you’re doing this work with the thrombolitics?

SPEAKER: Spasm? In what kind of disease?
DR. THORPE: There is a lot of spasm.
SPEAKER: Do you mean in stroke?
DR. THORPE: Yes.
SPEAKER: I don’t know. I didn’t try Emodepian in stroke but it is a possibility, which is interesting for sure, certainly in the future.

DR. THORPE: Does anyone else have intracerebral experience with nitroglycerine?
SPEAKER: Yes. Intra-arterial nitro, intra-arterial papaverine, intra-arterial nifedipine, all sorts of different agents have been used. We tend not to see spasm that often in acute stroke. We see it most often when we muck around in there and cause it. The first thing we do when we see that is we pull back the catheter and see if it will resolve, because frequently catheter spasm may be very transient. If it does not resolve we feel that papaverine is the best vasodilator and we use a dilute mixture of papaverine mixed with sterile water to see if we can reverse the effect of the mechanical spasm. This is distinct from the spasm that is associated with hemorrhagic stroke, of course, because that’s a very common occurrence and for that type of spasm we use a low pressure elastomer balloon. Papaverine has become the agent of choice for hemorrhagic stroke induced vasospasm.

SPEAKER: I have a couple of questions for the panel. I wonder if I could start a discussion about the future of mechanical approaches. It sounds like there is a view that we’re going to develop a wonder drug that’s going to lyse everything and we’re just going to give lytics and stop there. Will there be a future role for doing emergency angiography and mechanical interventions in acute stroke? And the second issue involves a specific case for the cardiologists where a patient with a big anterior infarct presents with a huge stroke, most likely a clot from the heart that’s gone up and caused a problem. What do you do when you see that right in front of your eyes in the cath lab? Today what would be the approach for trying to do something for those patients? You have the technology to treat those kinds of patients. I’d like to initiate the discussion with those two questions.

SPEAKER: I’d like to address the second question. We’ve treated several patients from the cath lab who’ve come to us with complications from cath procedures and I presume that what happened was that in working in the aortic arch something was knocked off. We’ve treated one that was a clot associated with an atherectomy. The caveat is, of course, that all of the work that Dr. Theron refers to and that I refer to is level 5, level 4 type evidence. There are no prospective randomized studies that show the utility of catheter-directed thrombolysis. That needs to be

From the 4th Biennial International Andreas Grünzting Society meeting held in Aruba, February 4-7, 1996.
done to prove what I think it will, which is that
this approach is useful with regards to stroke.
There is a difference between stroke and MI. In
MI you always have clots in the target vessel,
whereas you don’t with stroke. The majority of
vessels where the clots occlude are perfectly nor-
mal underlying the clot, so that if we interven-
we’re treating a normal vessel. Now as it turns
out I’ve done one procedure where I did not
want to use thrombolytic agents because the per-
son presented with multiple aneurysms, and had
a hemorrhagic stroke. I couldn’t use thrombolyt-
ic agents so I tried an intervention and it
worked. I was surprised that it actually
improved the patient. But I think the basic
pathophysiological differences make it very
unlikely that angioplasty of stroke in intracranial
vessels would ever be something comparable to
what has been examined in the heart, which is
direct angioplasty competing against thrombol-
ysis. This is a very different pathophysiology in
that most of the time the vessel is normal.

DR. JIRI VITEK: What you are saying is true
and I think the only way to advance in the treat-
ment of stroke is to consider that MI and stroke
are exactly the same. I think the only difference
is that the brain can bleed after thrombosis and
the heart doesn’t bleed and I think this is the
only real point. For instance, when you’re in the
cath lab and have a stroke during the cath lab
procedure, you are in the best conditions to treat
your patient if you can remember this. The first
half hour is critical to recover as much brain
function as possible. This is a major point. I
think at the moment cardiologists have a psy-
chological block considering the brain in this
type of problem. But they can treat it. The neu-
rologists have not understood that it is similar,
which may be the reason why it’s so complicated
to get the patient from the neurologist.

SPEAKER: I have a question. We have a very
active lab and from time to time we see these
cramps of patients. Sometimes during angiograms
we see particles, even calcified particles inside the
medial cerebral artery. Is there any way to aspir-
ate these because sometimes with urokinase you
cannot clean them out?

DR. VITEK: In the medial cerebral artery, so far
the answer is no. But you can improve the patient
by reducing the thrombosis around the frag-
ments. So it’s better to do thrombolysis even if
you suppose that there are fragments and not
only clot. I think it’s better to do it. You improve
collaterals and the general situation. Aspiration is
not advisable in the carotid artery.

SPEAKER: We had a couple of cases where we
couldn’t solve the problem just with urokinase.

DR. VITEK: Perhaps you didn’t solve it, but
you may have reduced the stroke.

DR. ROUBIN: I want to challenge what’s
being said so far. I don’t know what Dr. Vitek’s
impression is, but I think it’s worth looking at
the acute stroke intervention program that is
underway, headed up by Camillo Gomez, a
neurologist, which has been in place for the last
6–8 months. This involves patients who present
in the emergency room with a large hemorrhag-
ic stroke, and who have a CT scan which is neg-
ative for hemorrhage. What we’ve seen almost
invariably is an occluded or TIMI-2 flow
occluded bifurcation or TIMI-2 flow. There
have been a couple of cases with middle cere-ral thrombus. So in light of the previous dis-
cussion, I think it depends on what type of
strokes you’re talking about. I think there is an
opportunity for acute mechanical intervention
in a certain very important life threatening
subset of strokes. I think that wasn’t clear from
some of the comments made. I would be inter-
ested in Dr. Vitek also commenting on this.

DR. VITEK: I would like to say that the idea of
a 6-hour window is a mystique. Recent results
have demonstrated that the systemic treatment
with rTPA is giving better results than angiogra-
phy. The treatment with urokinase intracranially
is to put it directly into the middle cerebral
artery and inject the drug. It’s not clear if this is
the best approach. One of the things that may
help is the increase in blood pressure from
mechanical disruption, which helps the collater-
als in the brain. We have some good results with
this mechanical disruption in opening the artery
with PTA and stenting, even with the PTA in
complete occlusions of the middle cerebral
artery, which were much faster and sometimes
much better than with urokinase. So all that I
want to do is to caution all of you not to rely too
heavily on urokinase injections. Try to do an
arteriogram. The urokinase may take as much as
an hour to work. I have heard that systemic
rTPA is giving better results than direct injec-
tions of the urokinase intracranially.

DR. ROBERT FERGUSON: We’ve done 86
patients with thrombolytic therapy. I think proba-
bly Gary is right. We do have a selective popula-
tion in that the word has gotten around the hospi-
tal that we can treat complications, so we proba-
bly have a referral bias from people who are
doing angiography in cath labs. I can tell you,
however, that in our experience it’s probably
around 40% of patients who have no occlusion of either carotid artery. We presume that the emboli come from the heart, which is consistent with the literature. In some series it’s higher than that, but it is usually around 35–40% of all stroke patients are believed to have cardiogenic emboli. In those patients there’s no role for mechanical intervention. In the subset of patients who do have so-called artery to artery emboli it’s been our experience that probably only about half of those patients have a critical stenosis of the carotid artery. What they tend to have is a stenosis which is non-occlusive. I’m not debating that it should be fixed eventually. The question is should that stenosis be treated immediately at the time of stroke intervention? If you’re doing angioplasty and stenting and you have the technology, I think you can pose a good argument for doing it. It is still a minority of patients in whom we see an occlusive lesion in association with intracranial thromboembolism.

DR. VITEK: Yes, I agree with Bob. Most of the patients don’t have disease of the intracranial arteries. We have the same results. But the patients who have the problem can be effectively treated with mechanical approaches

DR. ROUBIN: I think the critical question is, what if it’s you in this situation? If it’s you with a 90% lesion, are you one of the 20 to 30% that is having a major hemispheric stroke? How can we recognize this non-invasively? Are there any techniques, or should all patients come for emergency cerebral angiography? How should we be approaching this?

DR. VITEK: My feeling is at the moment that there is only one way to treat these patients effectively and as fast as possible, and that is to make it a rule that stroke patients should be referred to the CT department to save time, and then in the CT department a neurologist should evaluate the patient. A complete angiogram is mandatory to be sure that the arteries are not involved in the occlusion. This is a key point because it changes the possibility of thrombolysis.

DR. FERGUSON: I agree with Jacques. However, there is new technology, such as Magnetic Resonance Angiogram (MRA). Some neurologists are in fact bypassing the CT scan for an MRA to get an MRA to rule out a parenchymal hemorrhage. The theory is that the hemorrhages that you miss earlier on an MRA are going to be subarachnoid hemorrhages and they don’t present clinically the same way, so that the MRA would get you a look at the arteries and the parenchyma of the brain quickly using echoplane MR imaging. Then if those patients have an occlusive lesion you immediately go on to angiography and thrombolysis. If you do an MRA and the brain vessels are totally clear then you have to assume that you may be dealing with one of the mimicking conditions. There are 30% of patients who present in the emergency room who are thought to have stroke but have no occlusive lesions, or Todd’s paralyses. There are all sorts of conditions which mimic ischemic stroke and certainly some of those will be excluded by something like a magnetic resonance scan. So that is an alternative. We still don’t use it. We do CT, but in the future there may be other ways of doing it.

DR. ROUBIN: I’d like to move on now to what these efforts are designed to try to prevent, which is the cerebral vascular occlusion. Is there a comment?

SPEAKER: I just wanted to support what you said, in that there is a certain subset of patients where direct intervention might be possible. We have had two such patients in the last 9 months. One was a patient who had a cardio-angiogram done and 24 hours later had a massive left hemispheric stroke. We knew that about 80% of left intracranial arteries stenosed. We took the patient to the cath lab within an hour and what we saw was a near occlusion. I think I shared the film with Richard Myler. There was a TIMI-2 grade flow. And we did direct stenting and the man walked out of the hospital within 72 hours. We had another patient who came with an acute right-sided stroke. We took him directly for a CT scan. The CT was negative and we performed direct stenting and he walked out of the hospital in 48 hours with minimal right arm weakness. I think there are certainly situations where we should not do anything or use thrombolytic therapy. It will probably be a therapy for some subset of patients.

DR. FERGUSON: There is no doubt what you say is true. I’m not arguing that there isn’t some subset. I have advised to deliberately occlude an internal carotid artery for a patient presenting with TIAs. This is very different from the situation of the heart, primarily because of the collateral network at the base of the brain. One thing I’ve learned from this meeting is the importance of revascularization and what I hope to give back is some experience and techniques that we use in our radiology that are foreign to the group here. But for the first 10 years of my involvement with neuroradiology, most of what I saw being done elsewhere was closing off carotid arteries. We close off carotid arteries all the time. It is clear
that you can. In fact, if you take 90% of patients off the street, you can occlude their carotid artery and have nothing happen to them clinically. That’s a fact. So the majority of patients who present with ischemic events do not need that. They’re having ischemic events because they have emboli that arise in conjunction with an athero-occlusive lesion. Therefore, it may be appropriate in some patients, particularly patients where typical devices cannot reach safely, to occlude their carotid arteries rather than try and open them. For example, in a very tortuous, circuitous carotid artery, that might actually be a reasonable therapy. I don’t know how Dr. Theron feels about that.

DR. THERON: Yes, I agree. I didn’t show it because of the time, but in most cases we do not try to open the artery when it is occluded. We thrombolyze in the other arteries. We thrombolyze in the vertebral artery, in the opposite intercarotid because we want the flow of the thrombolytic drug to reach the parenchyma and the collaterals because otherwise, as Bob said, the intercarotid are treated when there is no thrombus in the middle cerebral arteries and that is important.

SPEAKER: Bob, would it make any difference if you see a reduction of flow, say TIMI-2 flow, in a critical obstruction? Would that be a case where a mechanical is warranted?

DR. FERGUSON: Yes, I agree with that situation of no flow in a carotid artery. I had a patient recently, about 87-years-old, who had a trickle of flow in the carotid artery. Now that carotid artery is not critical for that woman’s well-being. It took about 10 seconds for the flow to reach the brain when you injected that carotid. But it is a potential source of emboli. So the risk comes not from having the artery shut. It comes from having it open if emboli move antegrade. But in a patient who does not have adequate collaterals, closing that carotid would be devastating. Opening it may be lifesaving. You have to identify that subset of patients.

DR. ROUBIN: Let’s pose the question to some of the other panelists here, that is, the question about cerebral revascularization. This is a concept that we’ve become familiar with in the heart. I’m not sure that I agree that we should let arteries go in the heart as much as we should let them go in the cerebral circulation because eventually you run out of arteries. When you get atherosclerosis in the contralateral vessel in a 99% lesion, you’d be very thankful to have this contralateral artery patent. Let me ask Constantine and Stefan, some of the other panelists, Mark, if they want to make any comments about that concept.

DR. MARK WHOLEY: I’m a peripheral angiographer and my responsibilities stop at the junction of the proximal and middle third of the carotid artery. So it’s difficult for me to answer this question. I agree that in a vascular operation it’s a wonderful idea to occlude the carotid artery. I’d also like to address something else. I spoke to my interventional neuroradiologist, who is excellent, and he is unable to get any patients for carotid PTAs and TIA because the surgeons said they have actual morbidity statistics under 2 to 3%. As we know, the percutaneous technique is really unknown in terms of morbidity. We know that standard angiography of the head carries morbidity statistics of 1⁄2 to 1 1⁄2%. Temporary occlusion of intracarotid artery with a balloon for 15 minutes carries a 2-3% morbidity. So just getting a catheter up there already has a significant impact on morbidity. You are going to have to expect at least a 2 to 5% morbidity doing PTAs with a carotid. Is this fair?

DR. THERON: It’s what we have. We have performed 38 PTAs, carotid PTAs without protection. At the beginning of our experience we had an 8% embolic complication. After we performed 95 cases with protection we had 0% embolic complications, but we had a 5% dissection rate. We have now performed around 150 cases with protection and when it was necessary for us to treat a dissection, we performed this with a stent. Now we have 0% thrombotic complication rate and a 0% dissection rate. We have had some minor bleeds. So we at the moment with protection and stents we have results that are better than surgery.

DR. STEFAN BEYER-ENKE: I suppose you will have to standardize it by means of immediate diagnosis, for instance, MRI immediately or with a Doppler. If you have a totally occluded artery and you try to reopen it, and if it’s partly open, you might do a systemic therapy or a transcranial Doppler to determine the situation of the vessels.

DR. RICHARD MYLER: I wonder if I might relate briefly a recent medical case. One month ago, on New Year’s Day, an 87-year-old woman had an hour-and-a-half episode of expressive aphasia without any motor sign abnormalities. Four years ago she had a successful coronary angioplasty and has been angina-free since. A neurologist saw her the following morning and recommended studies which revealed a 99% stenosis in the proximal
left internal carotid and a 50% stenosis in the RICA (carotid stenting was not available at that time in this hospital). What might you recommend for this lady? And if she is your mother, what would you recommend?

Well, she is my mother and (for once) I told her that in this picture I was her son, not her MD! She was seen by our vascular surgeon who advised and subsequently performed a left carotid endarterectomy. The operation lasted about 1 hour. She did well, except for a transient left lower facial palsy (lasted about 1 month). As much as I am impressed with carotid stenting, I wonder if this heavily calcified subtotal (99%) RICA stenosis could have been addressed with this procedure.

DR. ROUBIN: Maybe we can get Mark Wholey to comment on that.

DR. WHOLEY: Richard, that’s an interesting situation you present. I just have a couple of comments and then I would like to ask the panel. I think that the speed with which these procedures are done is important, especially for the patient in a high risk category who could be enrolled in a stent program. The stents that we’ve done in that kind of situation I think have been done in 20–30 minutes, assuming reasonable anatomy. So I think in that particular case the stent was every bit as justifiable as the surgery. My question to the panel is, we have not found the tightness of the lesion to be a factor, or the characteristics of the target lesion, in contrast to the ABC classification used in coronary work. We have not found that the characteristics of the lesion have really affected the technical success or the morbidity. Has that been the experience? No, only in 42 patients. Regardless, if we can access the common carotid bifurcation we would have 100% success. The problem is accessing the common carotid because 10% of our failures are for complex aortic arch, whether aneurysmal, dilatation, aplatia, tortuous left carotid, or anomalous origin of the left carotid. That’s been the reason for technical failure. But has that been true for the experience of the panel?

DR. ROUBIN: That’s absolutely true. You’ll see that from the data we’re going to present later that you take out the people where we had problems with access, and the complication rate is something approaching 0%. Zero percent is an astounding number. It’s the access issues from the severe disease that causes problems.

DR. MYLER: Just one comment. Maybe I didn’t make it as clear as I could. But the surgeon with the stenosis in his hand could not put a probe across the lesion.

SPEAKER: Would it take an .014 wire?

DR. MYLER: It wouldn’t take anything.

SPEAKER: It wouldn’t take an .014 wire?

DR. MYLER: Well, perhaps.

SPEAKER: In other words it’s totally occluded?

DR. ROUBIN: It’s almost. He got a little bit of distal flow in his Doppler study and in his ultrasound. Secondly it was very heavily calcified.

DR. ROUBIN: It doesn’t represent what is in our experience, in 158 individual vessels, that does not represent a problem at all, I would say.

SPEAKER: And the calcification is subintimal. Calcific disease is ordinarily subintimal. So again that has not been a problem?

DR. FERGUSON: I just want to make one comment about Richard’s case. The point to me is not so much the technical issues here. The question is what is the right thing to do given the current state of the science and the current state of our knowledge. And when it comes down to a loved one, I think you tend to see things a little bit differently, perhaps a little more clearly and I don’t think we should lose sight of the fact that carotid endarterectomy is the single most scrutinized surgical procedure in the history of mankind. It has been subjected to four randomized, controlled clinical trials, validated separately on many occasions, and we have very good reason to put faith in that procedure. However, if you look at these studies, they are very selective in who they pick and there are really very significant exclusion criteria. How does it affect our interpretation? Gary and I may debate about this. That does not give us license, though, to extrapolate beyond what we know as science, and right now we have precious little methodologically sound, well designed scientific studies validating carotid angioplasty, or carotid stenting. I personally think we will. We need to have that before we can say with certainty that anybody’s mother should have an angioplasty or stent instead of a surgically proven procedure.

SPEAKER: It’s interesting that you talked about that, but what we have seen this morning is really technical demonstrations about pictures showing before and after results. And most of the time we’ve been asked to demonstrate the validity of something that we do, by looking at the clinical outcome. And nobody has really addressed that apart from saying, well, this picture is before, this picture is after and as I recall that is really the end result of what has hap-
Panel Discussion

pened to these cases. I have my opinions and most of what was talked about is extracranial. What do you do with these intracranial? Are these people improved after we do thrombolysis and how do you validate that? What scoring systems do we use? And nobody’s really addressed if any of this has really helped one iota apart from making us feel better because we get better pictures.

DR. ROUBIN: We need to continue with the next set of talks and can perhaps pick this discussion up later.