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Released: 02/27/2024
Valid until: 02/27/2025
Time needed to complete: 1h 08m

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The Frontier of Stroke Diagnosis (RapidAI): How Can Artificial Intelligence Improve Acute Care for Ischemic and Hemorrhagic Stroke?

Announcer:
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Dr. Gibler:
Our final speaker is Dr. Greg Albers, who I'm sure you're aware of his work in AI. And just looking today at the schedule for the meeting, that apparently is a very hot topic, which is no surprise to anyone in the audience with what's going on. Dr. Albers is Professor of Neurology at Stanford University, Director of the Stanford Stroke Center. And we are delighted that you're here. Thanks, Greg.

Dr. Albers:
Thank you. Appreciate the invitation, and a pleasure to be here. And yes, AI is controversial. Anytime you open up some news article, it's either telling you that it's horrible or it's wonderful, it's going to make our lives great or it's going to destroy our lives. So, we'll see what we can do with stroke. And we're going to talk a little bit about both ischemic and hemorrhagic stroke today. So, a little bit different for the last talk.

So, AI solutions have proliferated over the last several years. Ten years ago, you probably didn't see a lot of pictures of smartphones with all these brain images on there. And now, you see this all the time in practicing as stroke neurology. You have the opportunity to see images wherever you are, which makes it nice when you're on call to be able to see the images, and to communicate with your team, and to pull in information from the electronic medical record, as well as to give feedback to other physicians about how the patient is doing. So, just like the rest of our lives, we can do more from home than we used to because we have this technology.

And it's getting better and better. This is the new output screens for the multi-modality Rapid clinical viewer. And you can see it's basically like having a PACS station in your pocket, you can do most of the things that radiologists do on a PACS, now you can do off your smartphone. So, that's pretty nice.

But there are limitations. So, it’s important to know benefits and limitations when dealing with AI. One is that there are always going to be some false positives and false negatives. Some people think the computer should be perfect and it should never make a mistake, but we're nowhere close to that, so you have to be aware. And that's why clinician oversight is mandatory. Ideally, AI is going to find things that you missed. But you're also going to look and say, ‘Hey, the AI made a mistake here. This was an artifact that fooled it.’ So, the combination of the two should be better than either alone.

As AI changes rapidly, so do radiology protocols. And you have to train the AI on the protocol that it's going to be used on in the wild. Because if you didn't, you're not going to get the same response that you got, because the AI needs to match the protocol. So, if you think your results are not performing up to what was advertised, you have to first look, am I matching my protocol to the AI module. And I'll show you an example of that.

Okay, so let's talk about brain hemorrhage since that's the hot topic here tonight. And one of the most prolific AI modules that came out earliest was something that could detect a brain hemorrhage. And one of the problems with the early brain hemorrhage detectors were, one, they had false positives, about 5%. It sounds low, but when you get woken up in the middle of the night by something beeping that says a brain hemorrhage is suspected, and you look and look and look, and you can't find it, and then eventually realize there is no brain hemorrhage, that was frustrating. So, clinicians say, 'I want to get rid of the false positives.' They also wanted to have the volumes. And we've talked a lot about volumes tonight. So, having those is going to be helpful.

So, here's a new Rapid ICH 3.0. It's faster, picks up very tiny hemorrhages, and the sensitivity is super high with a specificity of 99.5%, which means that out of these 900 patients in this recent study, there were only 2 false positives. So, if it rings, you can be very confident that there is indeed a hemorrhage. And now in terms of the volume, it has been more challenging to get volumes cleared by AI devices. But this is a hyperdensity module that is FDA cleared. And last year at the same meeting, we reported that the Pearson correlation for the volume measured by the software is essentially the same as a neuroradiologist hand drawing every slice and then adding them up. Neuroradiologists don't have the time to do that, so they make approximations like ABC/2. And for complicated volumes, those are often not accurate. So, this can be helpful when you're trying to say, does this patient meet the criteria for the ENRICH procedure or something else, or you're trying to do these prognostic scores that are based on volume. And it also can be very helpful when you're doing the stability scan, right? So, 6 hours later you want to know is that hemorrhage growing? Oftentimes the radiologists say, 'Well, the head's tilted a little bit, not quite sure.' So, this detilts the brain and gives you an accurate estimate whether that hemorrhage is growing. And obviously for the clinical trial we heard about, that's very important to know that you've frozen the growth of that hemorrhage.

Big news for Friday should be these large, randomized trials that have looked at middle meningeal embolization to treat these chronic subdurals. And some neurosurgeons are predicting that this will be their most common procedure, as all us baby boomers move into the chronic subdural age range and start bumping our heads. So, I think there's a lot of enthusiasm that these will be positive trials. So, picking up these chronic subdurals is very important, and then being able again to follow them as they successfully shrink away after the middle meningeal artery is adequately embolized. So, AI can provide identification of not only acute subdurals, but the chronic subdurals. You can follow them over time, you can see if the midline shift is getting better. So, lots of things that can be done automatically to help you.

So, there is so much AI, virtually every week the FDA approves some new module. And you can imagine that if you have 15 modules blasting off on your phone, you're going to get overwhelmed. So, this is a breakthrough designation from the FDA that allows modules to start working together. So, that if it's a brain hemorrhage patient, you don't want to hear all about the ASPECTS score, right? And if it's an ischemic stroke patient, you want to know is there an LVO? Or what's the ASPECTS score? What's the Core? So, this module here called Rapid NCCT, first screens for brain hemorrhage, and then it looks for a hyperdense MCA sign, and whether there's early infarct signs in the MCA territory, and can pick up about 2/3 of the LVOs from a non-con alone. And I know that Brian likes to talk about these hospitals that don't have fancy equipment, and maybe they just have a non-con, so, here's a way that you can find out about an LVO with just your basic non-con CT scan.

Aneurysms are another type of brain hemorrhage that we didn't talk about today, giving us subarachnoid hemorrhages. And one of the things that you want to do is not miss them. We're doing so many CTAs these days looking for LVOs, once the radiologist finds the LVO, they may miss that PCOM aneurysm, right? So, you can screen for aneurysms that may be missed. The ones that are missed are typically small, maybe too small to clip or coil, so then you want to follow them. And using the aneurysm software, you can then see is this aneurysm growing? And you can do it in a more sophisticated way than the standard. Standard is a linear measurement, you move the mouse a little bit, your linear measurement is not exactly right. But here, you can do the surface area and the volume, which is something a radiologist can't do. And what has been shown at least in some preliminary studies is this will pick up aneurysm growth that can be missed by the neuroradiologist. Aneurysm growth is one of the biggest predictors of having a subarachnoid hemorrhage. So, this is something exciting, telling us we may be able to identify the patients who are at risk for aneurysm rupture more accurately, and then intervene and prevent subarachnoid hemorrhages.

Another thing that's exciting is to be able to do perfusion imaging in the angiography suite. This can be helpful for a couple of different reasons. People are always trying to get that door-to-endovascular-therapy time down. And particularly if it's a transfer case, if it's been a long time, you might want to reimage before you go into the procedure. But here, using a 1-minute scan off the C-arm from your angiography equipment, you can get a perfusion image, not quite as beautiful as what you get from the ER, but still gives you the same idea. It's going to tell you has the patient reperfused, right, they got TNK on the way over to your place, have they reperfused and don't need to have a femoral puncture? Has that infarct core grown greatly?

And then one of the more exciting things that is emerging is that people are realizing that after you do your thrombectomy and you think

you've got a great TICI score, that if you do a perfusion imaging, you'll be surprised to see that up to 1/3 of patients still have patchy areas of hypoperfusion. The job was not completely done in the cath lab. So, doing this scan at the end of your procedure can tell you, 'Hey, I'm really not done. And maybe we're going to need an intraarterial or an intravenous thrombolytic to finish the job.'

Limitations, I said, here's an example of when, where the field of view for the CTA didn't match what the settings are required for this LVO detection software. It looks like there's an LVO. This is not an LVO, this is a false positive because the protocol didn't match how the software was trained. So, you can see if you put it in for the appropriate field of view, then we don't get the false positive.

ASPECTS has the same thing. This was a case from University of Wisconsin where they said, 'Hey, the ASPECTS scores aren't working.' And they were right. When you look carefully, it was because they were doing thick overlapping slabs, a different protocol, and that was causing false positives. So, when you sliced it up thin, then the ASPECTS scores came back to where they should be.

So, promise of AI is large, and you can see there's a lot of exciting things. It's changing rapidly. But it's really important to know the limitations to make sure that you're using it to the best advantage.

Dr. Gibler:
Does anyone have a question for Dr. Albers? And then we want to open it. Excuse me for – yes, for Dr. Albers, and then we'll open it to the audience. Yes, sir?

Male:
When you recognize in your app that you're getting a lot of false positive, do you call the vendor to have settings changed or adjusted? Is that how you fix it?

Dr. Albers:
Yeah, I mean, you can call your radiology group, and again, the first thing that normally you look at is, is the protocol a match? Has there been a change in your protocol? Or what's the problem? Is it movement? Sometimes for CT perfusion, you get problems because the patient is moving during the scan. And then it's education of the techs to make sure they don't do the scan when the patient is moving. But definitely, you should go to the vendor if the performance you're seeing is not what's, you know, in the FDA clearance, or in the paper you wrote about it, you should check it out.

And it's also incredibly helpful if you find problems, to retrain the software. That's what it needs. It needs to know. That's how we got the hemorrhage software to get rid of false positives. It was collecting the false positives from users and saying what's causing them. And then when you figure that out, you can program the next one to avoid those false positives.

Dr. Gibler:
Other questions from the audience? The question is, how can you bring your radiology colleagues up to current speed, if you will, with AI, if that's appropriate? Is that a good way?

Dr. Albers:
So, you know, 5 years ago, you go to the ASNR meeting, and there'd be multiple talks about AI is out for our job, you know, we're going to put us out of business. And that is not at all the case, as I tried to mention earlier that really, what the radiologists should see is this should speed up their job. And radiologists these days are being asked to read more and more scans in less and less time. So, if you can, you know, give them the ICH volume automatically or you can find an aneurysm that they missed, that's something that's very helpful.

The other thing is, unfortunately, there's a lot of lawsuits for things that are missed by radiologists. So, if you have the AI looking over your shoulder and say, 'Hey, what about this? What about this?' radiologists may say, 'No, that's not true.' But there are going to be cases where the AI finds something that they missed, and that's going to help them. Right?

So, I think there should be no fear that it's out for any of our jobs. It just really makes us more efficient. As a stroke neurologist, when I'm transferring a patient from an outside hospital, it used to be a long discussion with that ER doc. Now I know exactly what I'm getting, and I can say, 'Yeah, perfect,' or 'No, there's nothing going on here that needs care at a comprehensive center.' So, it's a big time save, and preventing unnecessary transfers, huge cost savings for the hospitals.

Dr. Gibler:
Yes. So, repeat the question.

Dr. Albers:
Yeah so, the question is, is the aneurysm software just for picking up things in the acute setting? You know, picking up a subarachnoid hemorrhage, that's not the issue. Somebody has a subarachnoid hemorrhage, you know they have an aneurysm. But what's happened,

as I said, is there's a lot of CTAs being done, and it's frightening to realize how many of these aneurysms are being missed. The ones that are being missed are small, they need to be monitored in the outpatient setting. So basically, you're going to say, come back in 6 months to a year, get another one. And to be able to tell if it's growing or not, when it's small, can be challenging. So, the advantage of the AI is you co-register those aneurysms together, and then you can see that there's a bleb popping out or there's been a conformational change. So, it's very helpful in the outpatient setting. It's also very helpful for the patients to be able to have an easy way to see has their aneurysm changed. Because when you're trying to talk a patient into the fact that they need to have a procedure to coil an aneurysm, they're pretty nervous about it. But when they can see it, and they can see that it's actually growing, that means a lot to the patient.

Dr. Gibler:
We have a couple of questions for Dr. Parry-Jones regarding – thank you again, very much, Dr. Albers.

To implement care bundling, you know, you have to go to multiple disciplines. Do you have to identify a champion? And do you identify them regionally? Or within a hospital? Because if you're trying to do this, you'll need to find a way of making sure that somebody is going to be doing this when you leave, if you will.

Dr. Parry-Jones:
Yeah, no, absolutely. I think it's a very well-recognized thing for trying to spread any innovation really is that once you take it out of the environment it's been developed in where you've had someone championing it, you need someone who's really going to drive it forward in the new setting. So, we've definitely found as we've tried to scale up across the north of England, the sites that have done really well have had somebody who very enthusiastically wants to do it and really drives it forward and is willing to put that effort in. That's been a key thing.

Dr. Gibler:
Okay. Somebody from our audience also asked, does the likelihood of surgical intervention increase with care bundling?

Dr. Parry-Jones:
Yeah, so we actually found it did. Yeah. And we all we were doing was putting in place some criteria as to who you should consult the neurosurgeons about, but there was a slight increase in the number of operations that they did. Why? I don't know. I think one of the things which might have confounded it was that we were doing MISTIE III at the time. So, that meant that our sort of vascular neurosurgeons who were much more interested in intracerebral hemorrhage, were seeing all of the patients very early on for screening for MISTIE, and I think they were picking some of them up. So, I think that partly explained it. But who knows, it might make them more enthusiastic about ICH.

Dr. Gibler:
We had a very interesting question. And it kind of ran through a couple of things like LVAD, and this is this latest one is: How would you manage a young person with a spontaneous ICH if they have a mechanical valve and they are on warfarin? They have a moderate hemiparesis from a moderate lobar ICH, would you reverse the warfarin, first? And then secondly, when do you restart anticoagulation? And I would like to open that to the panel also for DOAC use. You know, this whole group that Dr. Connolly was talking about, you know, you look at it now, okay, when do you restart the anticoagulation on this person that has this baseline hypercoagulability? First, go ahead.

Dr. Parry-Jones:
Am I answering that? Okay. So, I think to the point of somebody taking warfarin with a mechanical valve, I would reverse it acutely, because I think in the short term, the risk of hematoma expansion in that, you know, those first few days, is going to be considerably higher than the risk of a thrombotic complication from reversing the anticoagulation.

Then the timing of restarting it is difficult. And I think in practice, it would probably be about 1 or 2 weeks later that I would. I'm not sure there's any strong evidence to say it should be different. But yeah, that's what I'd do.

And I think, I mean, I guess with mechanical heart valves, they won't be on DOACs. But the whole question of restarting it for atrial fibrillation, I mean, if possible, I'd randomize them. We're doing ENRICH-AF, so I'd randomize them into that. That's obviously closed to lobar bleed. So, I think I'm finding that challenging. And when they're fit enough, we'll try and refer them on for a left atrial appendage occlusion if that's what they're interested in. But I'd be very interested to see what comes out of ENRICH-AF and the other trials that are looking at, you know, avoid or restart.

Dr. Gibler:
How about our neurointensivists? Thank you for that, Adrian. How about our neurointensivists, when do you want to restart? You have a patient with an intracranial hemorrhage, when do you want to restart anticoagulation?

Dr. Cadena:
So, to answer the first question, absolutely, yes, reverse the warfarin. For resuming it, it I guess it kind of depends as well. But I agree, the risk of thrombotic events are very low in the first week or two. And so, when you're looking at restarting, I kind of gauge that. So, sometimes it's a week, sometimes it's 2 weeks. And honestly if you have a young patient with a large hemorrhage and they go to the OR, a lot of times our resumption of anticoagulation is depending on the comfort level of our surgeon, basically. But when I restart the anticoagulation, again, I think 2 weeks is safe. I start with heparin and neuro dosing, no boluses, and you basically increase the heparin to therapeutic level slowly with frequent CTs during that time.

Dr. Gibler:
Thanks, Rhonda. Natalie? Dr. Kreitzer?

Dr. Kreitzer:
Yeah, we do similar. The patient's, you know, with the mechanical valves, you know, I agree, definitely reverse. I think when you get into some of the patients, the ECMO, the LVAD, and the Impella, those types of patients, you know, they're very dependent on their anticoagulation. So, a lot of times it really is a lot of risk-benefit, generally they would require reversal. And, like Rhonda said, you know, when you're restarting on that heparin, it's that low dose, that lower aPTT goal, lots of head CTs, lots more than anybody likes, but that's typically what you have to do.

Dr. Gibler:
Great. Well, thank you all very much. We appreciate everyone being here tonight. We respect your time and we're actually going to end on time or at least 50 seconds over the time. But we very much appreciate everyone being here tonight. I wanted to thank our panelists. I've learned a tremendous amount, which I think I always look forward to having experts come in and teach me. We appreciate this very much. Thank you all.

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