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Complex Retrieval of Embedded Inferior Vena Cava Filters in Interventional Radiology

Narrator:

Welcome to **Medical Breakthroughs** from Penn Medicine, advancing medicine through precision diagnostics and novel therapies.

Dr. Caudle:

This is ReachMD and I'm your host, Dr. Jennifer Caudle, and with me today is Dr. Scott Trerotola who is the Baum Professor at the Hospital of the University of Pennsylvania. He is also Chief of Vascular and Interventional Radiology and Vice-Chair for Quality in the Department of Radiology at the University of Pennsylvania Medical Center. We will be discussing Interventional Radiology, the Complex Retrieval of Imbedded Inferior Vena Cava Filters. Dr. Trerotola, welcome to the program.

Dr. Trerotola:

Thank you.

Dr. Caudle:

So, let's first start out by talking about why filters should be removed. Can you discuss that for us?

Dr. Trerotola:

Originally there was a study called the PREPIC study which was completed near the turn of the century in which patients were randomly assigned to receive a filter plus anticoagulation versus anticoagulation alone. In this study, those that got a filter had twice the recurrent DVT risk, compared to those who did not get a filter, and that held up at both 2 and 8 years. So, that was our major reason initially, was we were trying to prevent recurrent deep vein thrombosis; however, over time, it turned out that the retrievable filters have a little bit of a problem in that some of them, pretty much all of them, but some more than others, can fracture and they can also penetrate symptomatically, and it is that fracture and penetration that caused the FDA to release an advisory, first in 2010 and then again in 2014, stating that filters should be removed when they're no longer needed.

Dr. Caudle:

Is there a way to predict complex removal of filters?

Dr. Trerotola:

There actually is. There are a number of different ways. If a patient has had any kind of cross-sectional imaging, but especially abdominal CT scan, one can look to see whether the tip of the filter is adherent to the wall of the vessel or penetrated to the wall of the vessel, and that is a strong predictor of complex retrieval. If the filter is fractured, complex retrieval is going to be necessary and if the filter is deeply penetrated, particularly if it is penetrated into the bone, in all likelihood, complex retrieval is going to be necessary. What we do when we bring the patient in to have the filter removed is we start with a rotational inferior venacavogram in which we get a circumferential view of the inferior vena cava to be able to see whether the filter is wall-adherent or wall-penetrated and that further allows us to predict that complex retrieval is going to be needed. The benefit of rotational venography over a simple anteroposterior, or even anteroposterior plus lateral venography, in predicting complex retrieval, is that if the practitioner going to take the filter out is not equipped to do a complex retrieval, they can recognize right away that that filter is imbedded and refer that patient to someone who's equipped to do so. A lot of people don't want to do forceps retrieval, don't want to do complex retrieval, and if they would just do the

cavogram, recognize that the filter is imbedded and refer, then they wouldn't spend 2 or 3 hours of fluoroscopy time and all kinds of additional work trying to get the filter out.

Dr. Caudle:

So, what is the success rate of complex retrieval?

Dr. Trerotola:

Complex retrieval has a lot of different definitions, so what I'd like to do is confine my response to the jaws-of-life technique, or forceps retrieval of filters, because that's one I can speak to in an educated way. The forceps technique for filter retrieval was developed here at Penn about 10 years ago. In that time, we've done about 200 of these and we published the first 100 of them earlier this year. In the 200 patients, we've had over 97% success rate in retrieval, and almost all of those had failed retrievals at the outside, including other types of so-called complex retrieval in which multiple snares and multiple accesses had been used.

Dr. Caudle:

Can you talk a little bit about how this complex retrieval is done? You did mention a little bit about it in your statements a little while ago, but can you talk more specifically about that?

Dr. Trerotola:

Well, the main reason that filter retrieval failure occurs is the tip of the filter becomes adherent to or imbedded into the caval wall. This is a result of the filter tilting against the wall and that little depression that's created gets covered over with intimal hyperplasia. Now, most of these filters have a hook at the top of them which is designed to be snared so that the filter can be easily pulled out, and if the filter is centered in the vein, then there's no problem with that. But, when that hook becomes imbedded in the wall or imbedded in tissue, there's no way to get a snare around it. So, what we do is we use endobronchial forceps to dissect that tissue away from the hook of the filter, then grabbing the top of the filter and pulling it free.

Dr. Caudle:

If you are just tuning in, you are listening to Medical Breakthroughs from Penn Medicine on ReachMD. I'm your host, Dr. Jennifer Caudle, and I'm speaking with Dr. Scott Trerotola, Stanley Baum Professor at the Hospital of the University of Pennsylvania. He is also the Chief of Vascular and Interventional Radiology, and is he is also the Vice-Chair for Quality in the Department of Radiology at the University of Pennsylvania Medical Center.

So, can you talk to us a little bit about how fractured filters are managed?

Dr. Trerotola:

Fractured filters are managed first by identifying what's fractured and where the fragments have gone. So, let me distinguish between those in which a fracture and embolization has occurred versus those that are locally fractured. If the fragment that is fractured from the filter is locally retained and extravascular, there's not much you can do about it, and usually we just follow those with serial imaging. In those patients, the risk-benefit ratio of going after them surgically doesn't favor doing so. If the local fragment is retained intravascularly, we can pretty easily get it using the same forceps technique that I just described. Other people have done that with snares, but we've found that snares aren't as effective as using the forceps to grab the fragment and pull it out. If the fracture is embolized, it is usually in the heart or the lungs, although it can be also in other areas such as the renal vein, the hepatic vein, etc. When we go after the ones in the lungs we use standard foreign-body retrieval techniques using long sheaths and snares to go up, snare the fragment, pull it into the sheath safely while it's still out in the lung, and then pull it back to the heart, completely encased in the sheath. The fragments that are intracardiac can be more problematic and are fortunately quite rare. Our experience here is with less than 10 of them and we've had about a 50% success rate in removing them, using similar techniques that I just described. There's recently been a paper published from the University of Michigan where they had 100% success with 8 such retrievals, using a combination of more elaborate cardiac techniques such as ICE and EA mapping.

Dr. Caudle:

So, what happens if some or all of the filter is left behind?

Dr. Trerotola:

Well, that's a very good question because it turns out that in about a third of patients, some or all of the filter is left behind, in our

experience. I'm in the process of actually writing up our experience with fracture fragment management right now. Most of those are completely extravascular and we really don't want to do anything with them because, as I mentioned, going after them surgically would be a very big deal and probably without really any significant benefit to the patient. As long as they don't continue to migrate or cause the patient any symptoms, there's really no reason to do anything about them. Now, migration outside of the body can occur. We have one patient whose fragment migrated to the right ventricle and actually migrated transcutaneously to the point where it was actually pulled out from her chest wall through a small incision. We've also seen several patients whose fragments have presumably been excreted in the stool, because they were originally abutting or in the duodenum, and the fragment that broke off simply can't be found using total-body imaging.

Dr. Caudle:

Are some types of filters more prone to complex removal than others?

Dr. Trerotola:

Well, let's distinguish between being prone to complex removal and being prone to fracture, because complex removal can occur with every type of filter and all filters become tip-imbedded, and our experience has involved every filter brand that's on the market. While the Recovery Series of filters tend to have had the most complex retrievals, they're also the largest number out there. So, it's difficult to distinguish whether it's on that basis or because of the filter itself. It does appear that the Recovery Series of filters have had the most fractures, especially early on, and those filters have since been taken off the market. These include the Recovery G2, Eclipse, and Meridian.

Dr. Caudle:

Well, I think that's actually a really great point and I like how you just said that. So, what are they?

Dr. Trerotola:

We've seen all kinds of different symptoms from penetrated filters. A filter that's merely imbedded generally won't be symptomatic, but when filters penetrate the symptoms depend on where the leg or the arm goes. If the penetration is into the spine, then the patient may have back pain, and we have several patients in whom immediately after removing the filter their back pain resolved. We've seen patients who've had--yes there is--and arms of the filter penetrate into the duodenum who've had gastrointestinal bleeding and, in fact, the arm or leg could be seen on endoscopy. Again, that gastrointestinal bleeding resolves when the filter's removed. We've seen patients with clot in the aorta and distal embolization as a result of penetration and we've seen patients that have had unspecified abdominal pain that's resolved with the filter removed; it's hard to say whether that was 100% because of the filter removal. Of course those patients who've had the most life-threatening symptoms are those who've had intracardiac embolization with cardiac tamponade and even some deaths.

Dr. Caudle:

Before we close, Dr. Trerotola, is there anything else you'd like to add?

Dr. Trerotola:

The message that we're really trying to get to practitioners who are taking filters out is that if they can recognize that the filter is imbedded right away, either by doing rotational cavography, or by doing multiple views, or by looking at CT scans, then if they're not prepared to do a complex retrieval, they can just go ahead and stop the procedure at that point and refer them to someone who is doing complex retrieval, such as us here at Penn.

Dr. Caudle:

Dr. Trerotola, thank you so much for being with us today and sharing your insights on complex retrieval of imbedded inferior vena cava filters.

Dr. Trerotola:

It was my pleasure.

Dr. Caudle:

I am your host, Dr. Jennifer Caudle, and thank you for listening.

Narrator:

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