Case of the Day
August 2014

Case courtesy of John Chung, MD, FRCPC
University of British Columbia

A 39 year old Caucasian female with previous liver transplantation secondary to Wilson's disease had a CT scan performed.

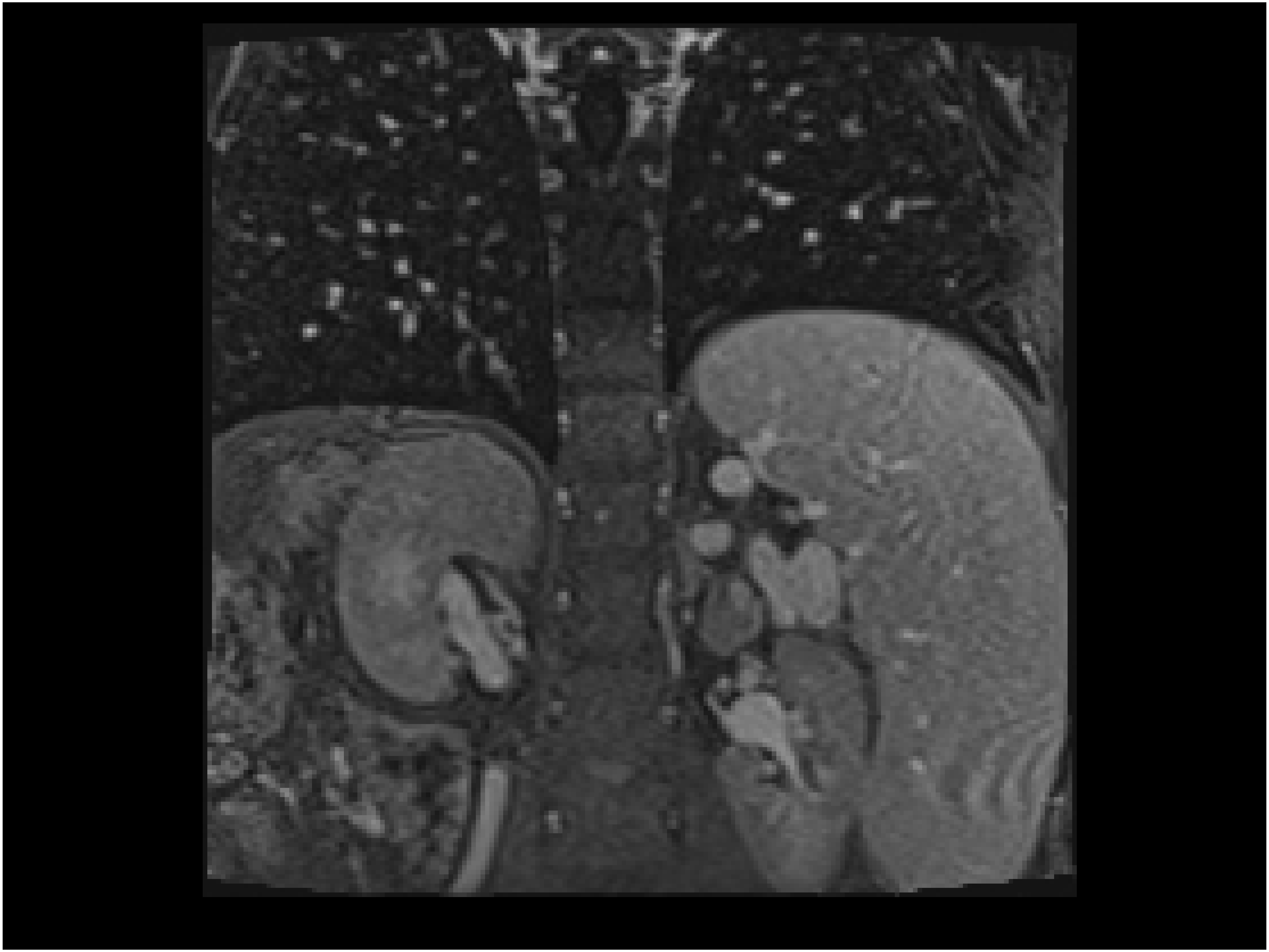
The CT scan demonstrated a 3 cm splenic artery aneurysm.

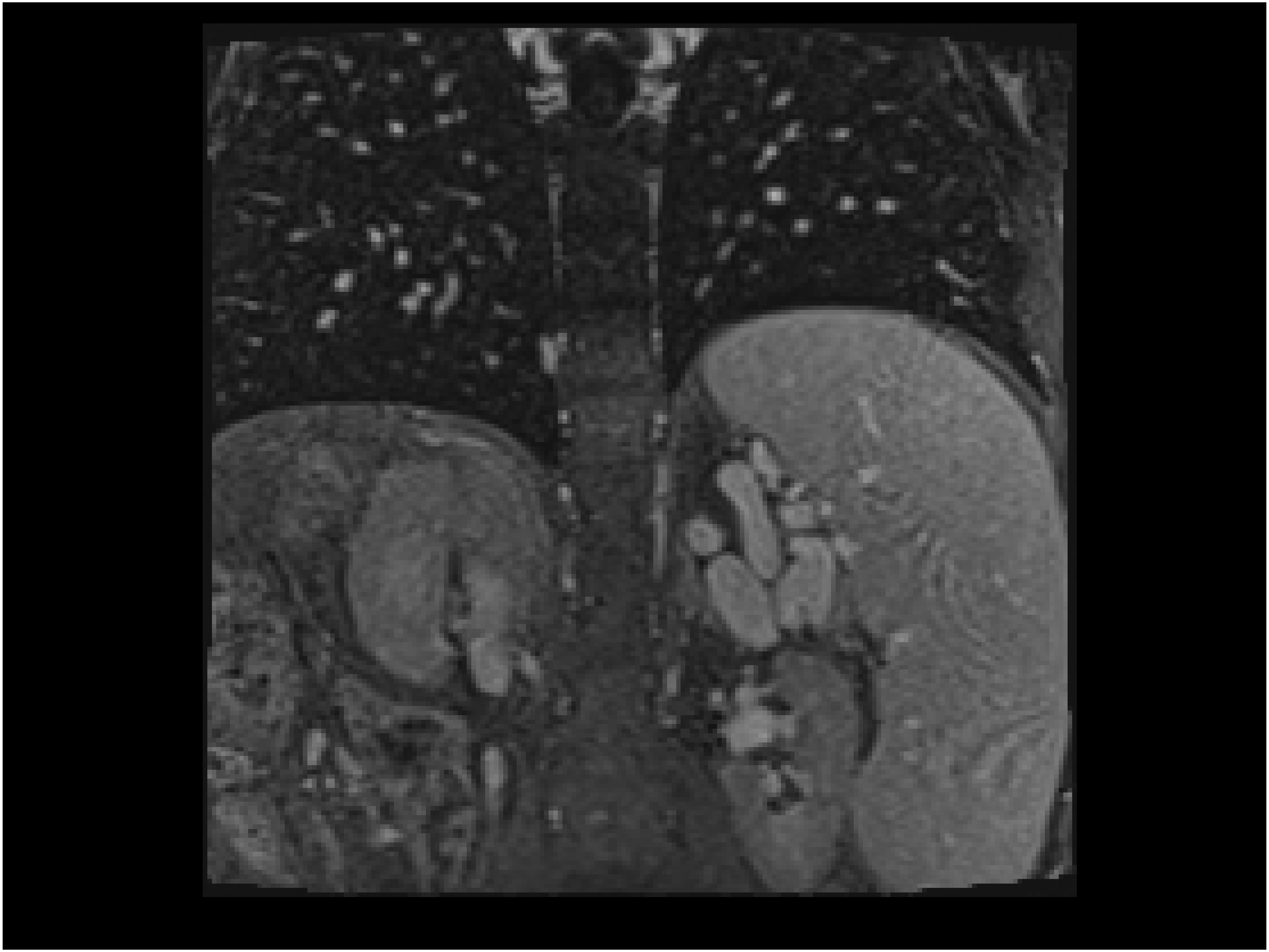
She was consulted to IR but had become pregnant in the interim.

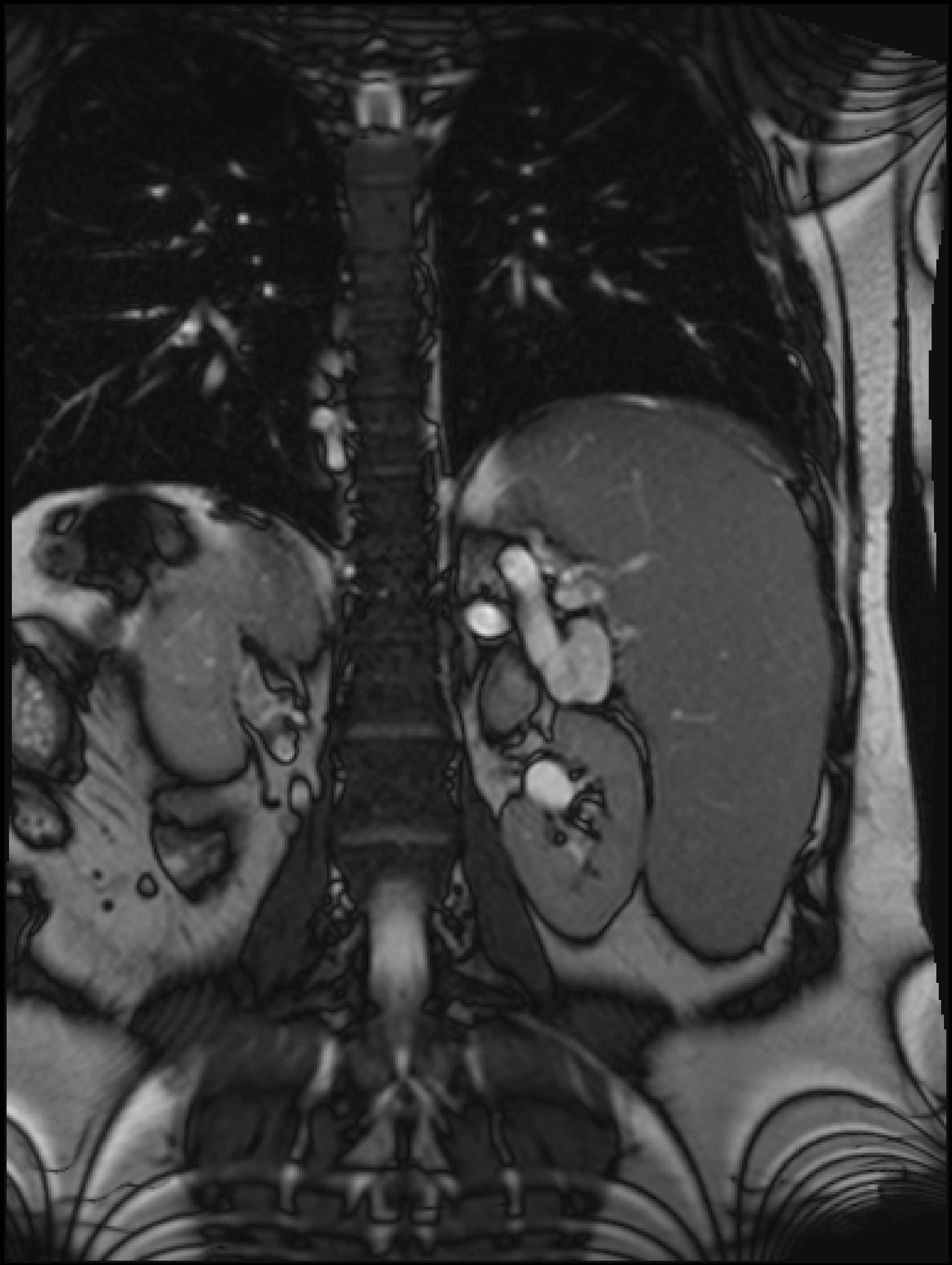
What should be done next?

Are there any special considerations given the clinical history?

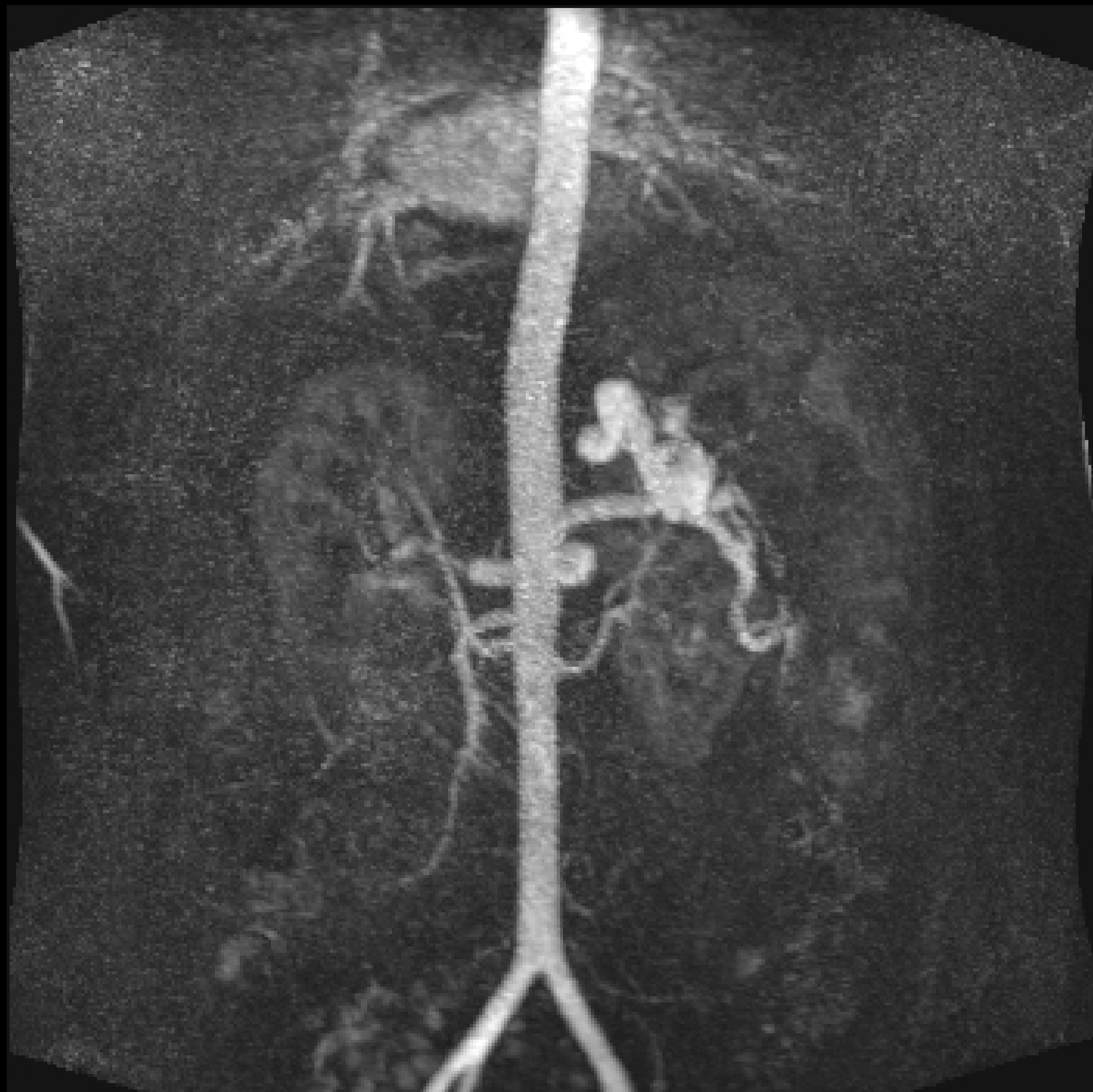
How would you limit radiation to the fetus?



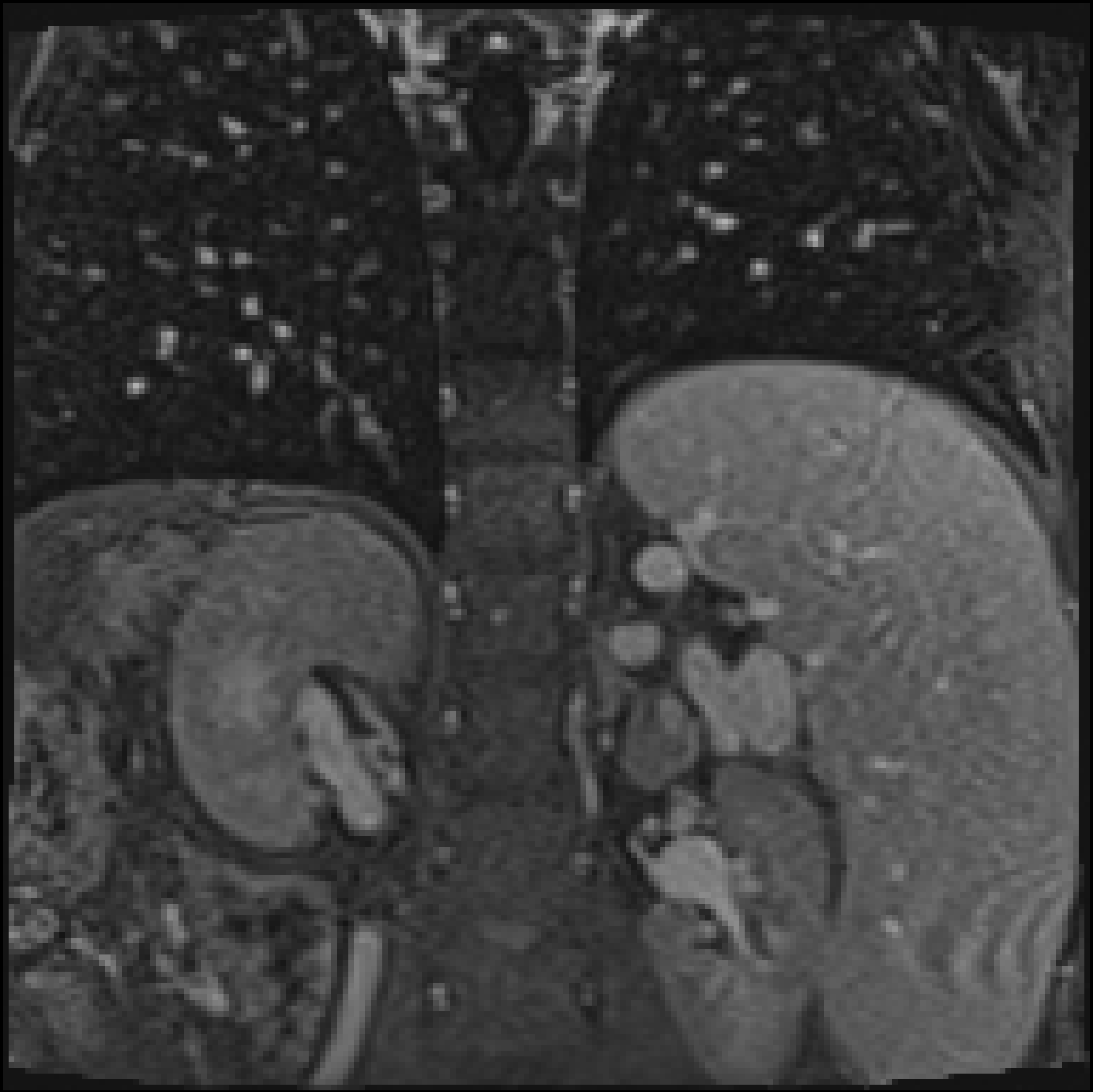




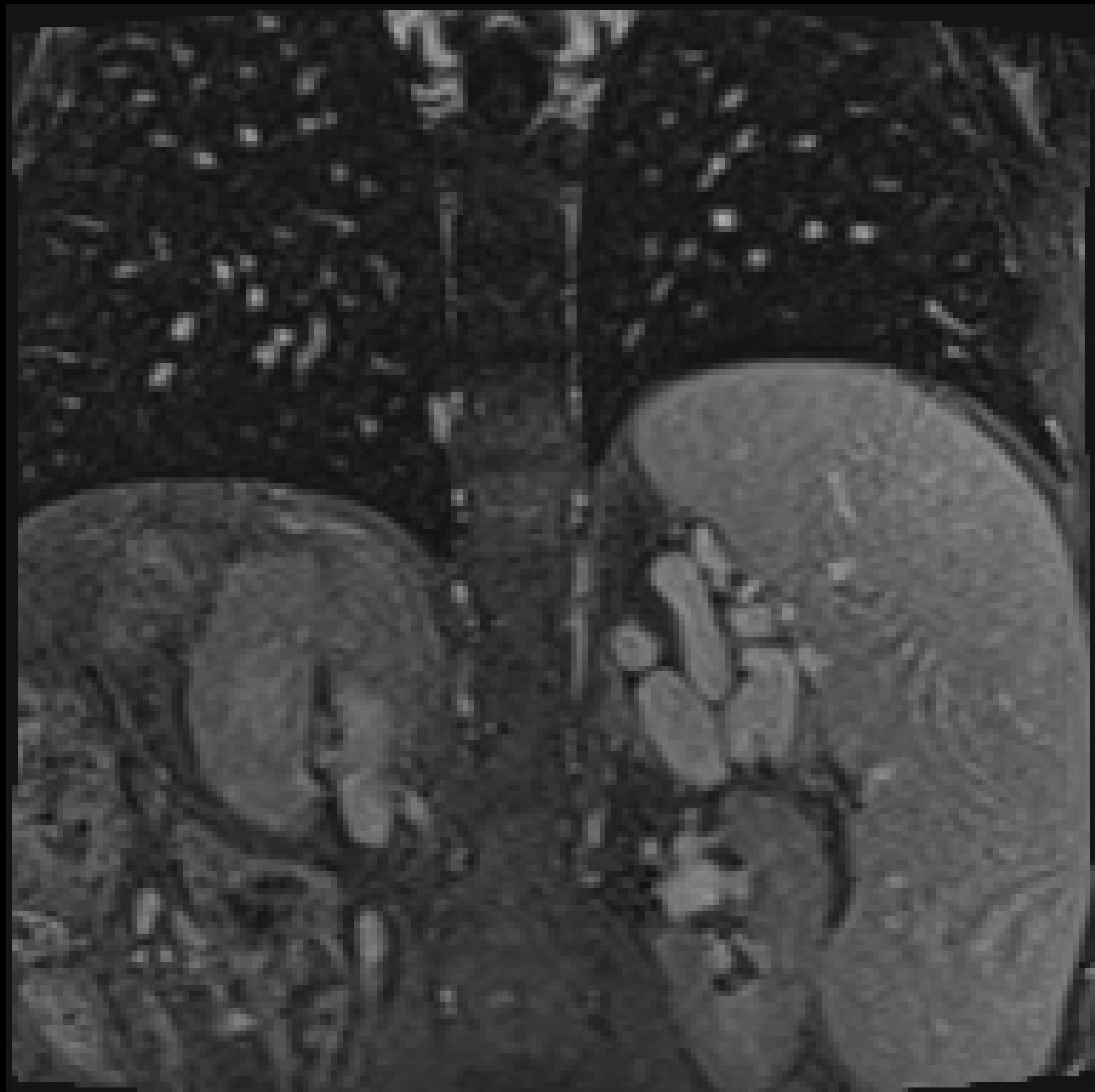
Coronal TRUFISP image, demonstrating wide-necked splenic hilar aneurysm



Coronal TWIST image, depicting MRA appearance of aneurysm



Coronal 3D VIBE image, again showing the splenic hilar aneurysm

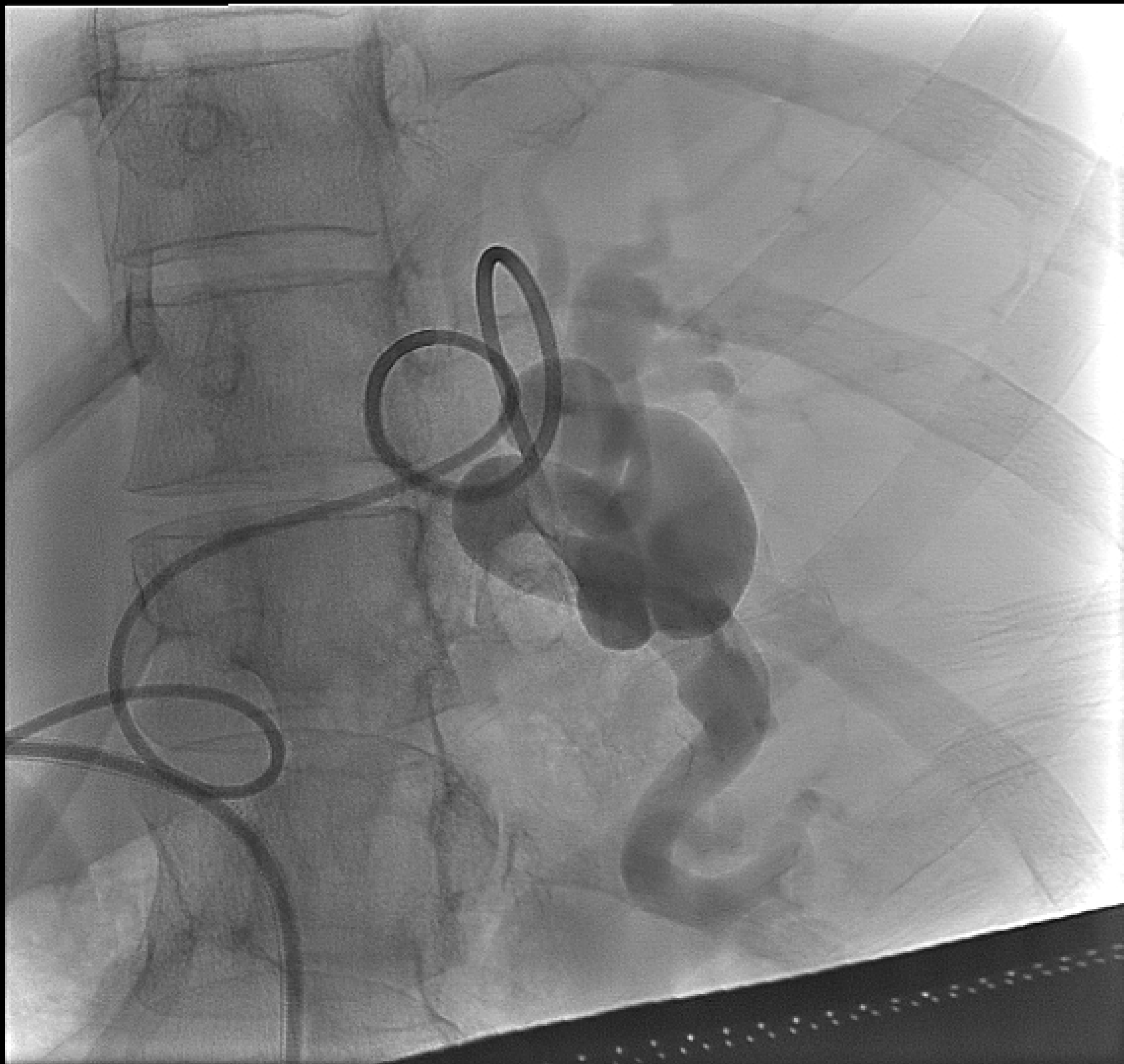


Coronal 3D VIBE image, demonstrating a branch arising superiorly from the aneurysm

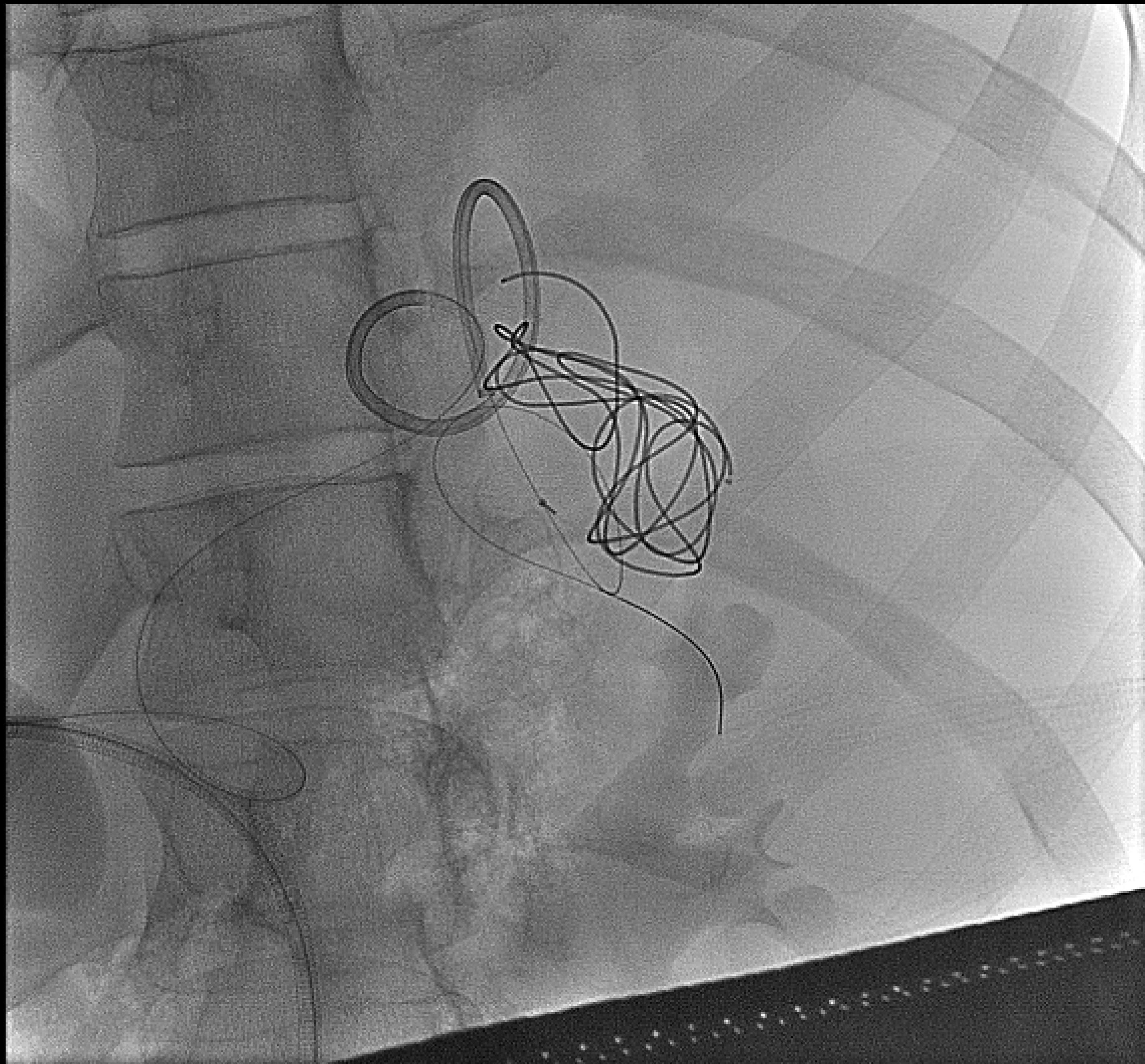
A pre-procedural MRA of the abdomen was performed to better outline the anatomy of the splenic artery aneurysm.

This demonstrated a splenic hilar aneurysm measuring 3 cm in size, with a 1.4 cm neck.

A solitary branch was seen arising from the superior aspect of the aneurysm, which the aneurysm otherwise isolated from the remainder of the splenic arterial circulation.



Unsubtracted splenic angiogram image through Neuron guide catheter



Initial coil pack formation within the splenic artery aneurysm

Final coil pack in splenic artery aneurysm

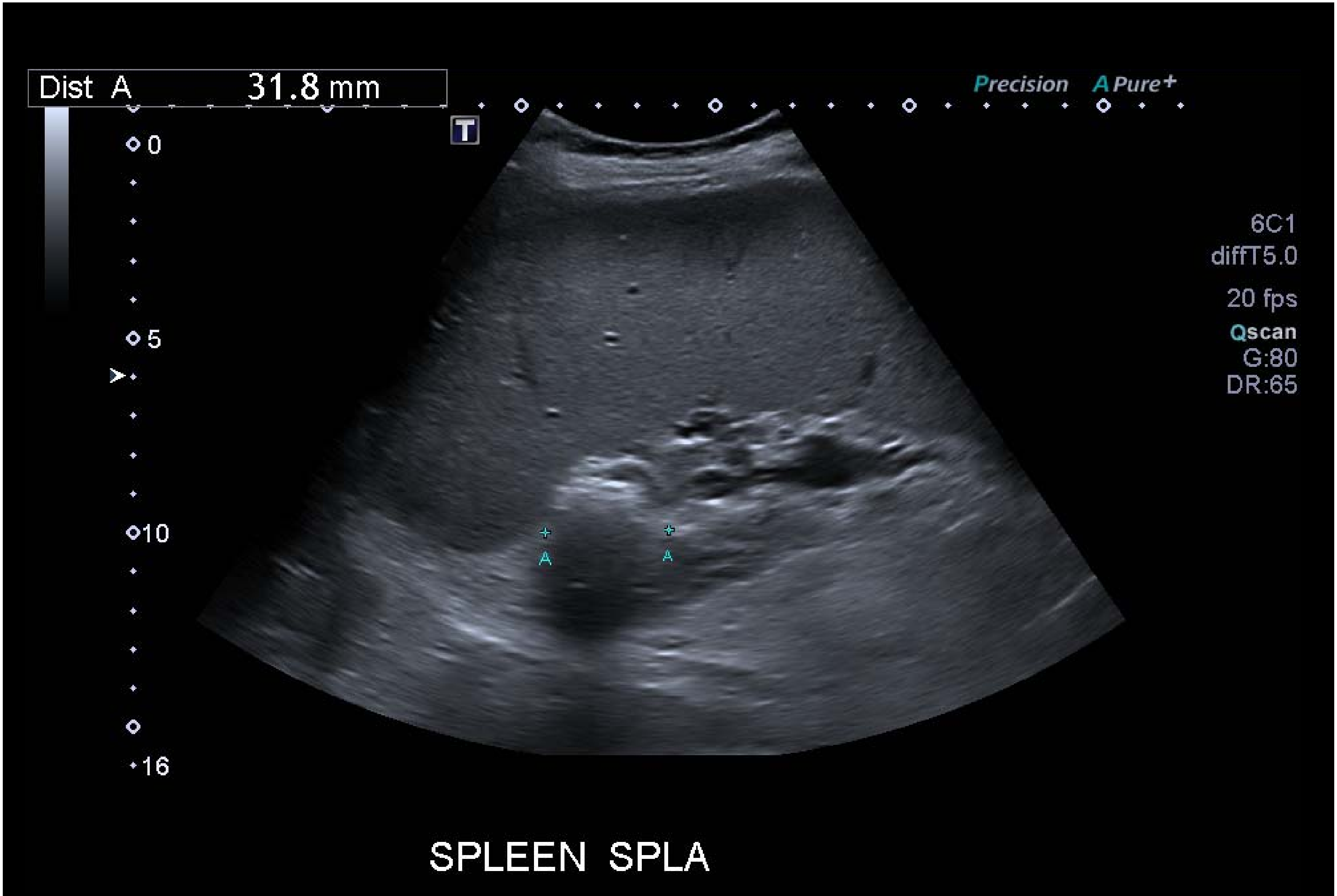
Right CFA access was performed under sonographic guidance, followed by placement of a 7-French 45 cm long RDC guiding sheath, which was advanced under fluoroscopy to the celiac axis origin. Through this, the combination of a 4-French DAV catheter and angle-tipped hydrophilic wire were advanced into the splenic artery. DSA at a low pulsed rate was then done to delineate splenic arterial anatomy. Following, the DAV catheter was removed and a 6-French 95 cm long Penumbra Neuron guide catheter was advanced into the distal splenic artery; the flexibility of this specific guide catheter allowed for successful negotiation through multiple loops of the tortuous splenic artery such that its tip was positioned just proximal to the aneurysm.

A double Tuohy-Borst technique was then used to allow for two access points through the Neuron guide catheter. One access point allowed placement of an angle-tipped Penumbra PX Slim microcatheter into the aneurysm and out the solitary exiting branch arising from the superior margin of the aneurysm – aneurysm coiling would be done through this microcatheter. The other access point allowed placement of an exchange length floppy Transcend microwire and Excelsior SL10 microcatheter in the parent splenic artery to help localize the neck of the aneurysm.

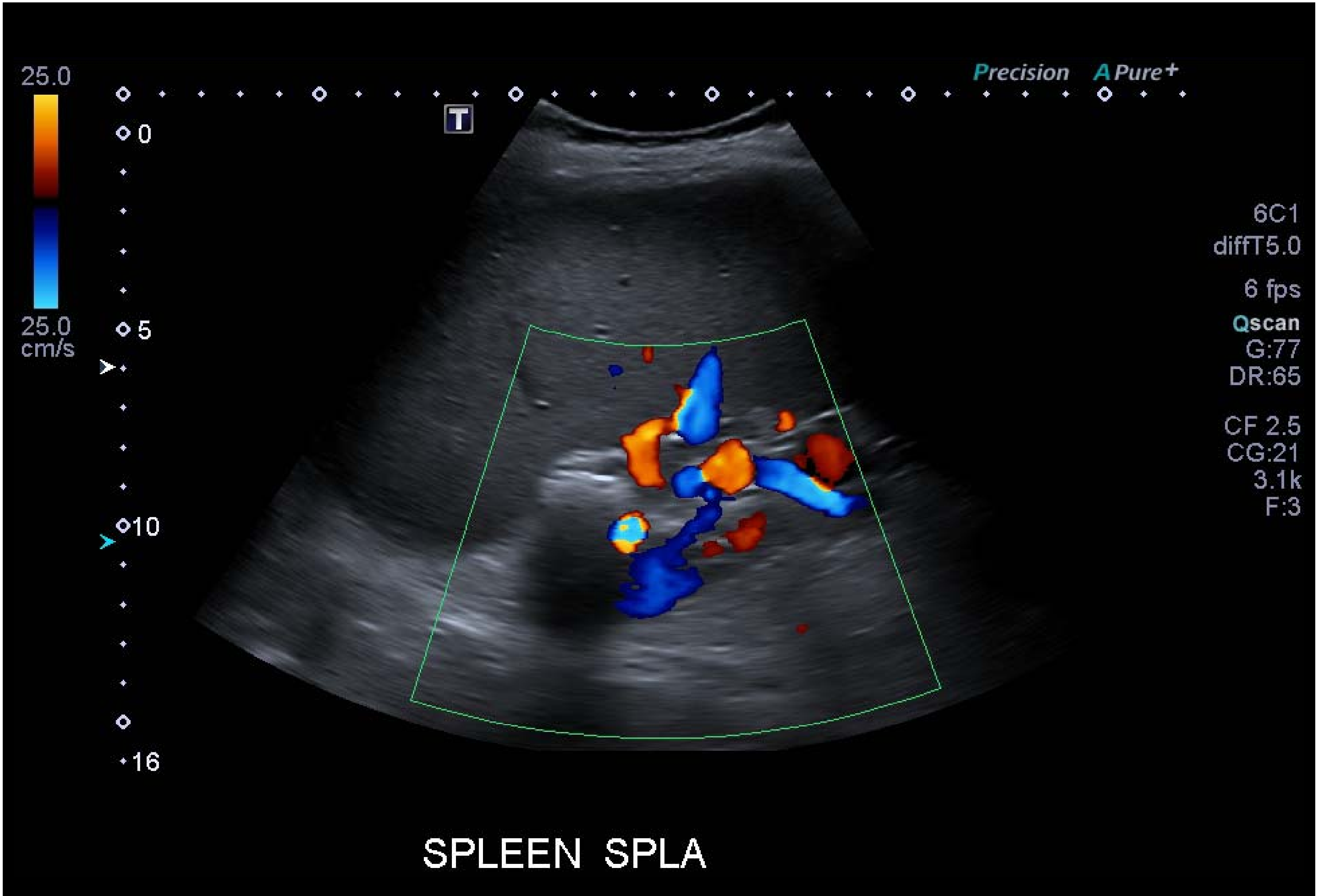
The aneurysm was subsequently successfully embolized using a large number of detachable Penumbra and Boston Scientific Interlock coils. Groin access was secured with the Per-close technique.

On follow-up ultrasound assessment, no residual vascularity was detected in the coiled aneurysm.

The patient went on to give birth to a healthy baby girl without complications.



Greyscale image of coil embolized splenic artery aneurysm



Color Doppler image of coil embolized splenic artery aneurysm

Discussion

Maternal fetal medicine and vascular surgery were consulted to better determine whether to treat the aneurysm conservatively or aggressively.

Numerous case reports and case series were referenced, including one by Ha *et al*[1], in which 32 cases of splenic artery aneurysm rupture in pregnancy were reviewed. In this review, more than half of the ruptures occurred spontaneously in aneurysms < 2 cm in size, with a maternal mortality of 21.9% and a fetal mortality of 15.6%.

Her vascular surgeon strongly recommended treatment rather than surveillance. He was hesitant to perform surgery on her, given that her previous liver transplantation would make re-opening the abdomen challenging and intra-operatively the potential for substantial blood loss could increase the risk of fetal demise.

The patient was therefore referred to Interventional Radiology for endovascular management of the splenic artery aneurysm.

Factors to Consider Prior to Intervention

Prior to proceeding to intervention, several key factors had to be considered. These included:

1. limiting radiation effects on the fetus;
2. assessing for appropriate sedation/anesthesia intra-procedurally as well as post-procedurally; and
3. considering prophylactic vaccination of the patient in case post-intervention splenic infarction occurred.

Limiting Fetal Radiation

A medical physicist was consulted to aid in optimizing this factor.

Although radiation to the fetus should be performed as late in pregnancy as possible to minimize effects on fetal development, the risk of aneurysm rupture is also highest in the third trimester of pregnancy. The recommendation was therefore to perform the intervention in the mid to late phase of the second trimester.

Standard practices of intra-procedural dose limitation were also stressed to the Interventional Radiology team – these are well outlined in a comprehensive standard of practice guideline issued jointly by SIR, CIRSE, and CIRA[2].

The most conservative dose to the fetus was estimated at less than 50 mGy; consent was obtained based on this value. A no greater than 0.1% increased risk of fetal malformation from baseline and a 0.4% increased risk of childhood cancer from baseline were cited.

Intra-procedural measures to limit radiation exposure:

- Exclude the conceptus from the direct beam if at all possible.
- Consider arm or neck access instead of groin where appropriate.
- Keep beam-on time to an absolute minimum.
- Consider use of intravascular ultrasound in place of x-ray for portions of the procedure.
- Consider optimal status of the bladder (pre- or post-void) based on the procedure and dose estimates.
- Remember that dose rates will be greater and dose will accumulate faster in larger patients (such as mid- to late-term pregnant patients).
- Keep the tube current as low as possible by keeping the tube potential (kVp) as high as possible to achieve the appropriate compromise between image quality and low patient and conceptus dose.
- Keep the x-ray tube at maximal distance from the patient.
- Keep the image receptor (image intensifier or flat-panel detector) as close to the patient as possible.
- Do not overuse geometric magnification.
- Remove the grid during procedures on small patients or when image intensifier cannot be placed close to the patient.
- Always collimate as tightly as possible to the area of interest.
- When the procedure is unexpectedly prolonged, consider options for positioning the patient or altering the x-ray field or other means to alter beam angulation so that the same area of skin is not continuously in the direct x-ray field. However, be mindful that such angulations could increase internal x-ray scatter to the conceptus.
- Allow for posterior–anterior beam projections whenever possible.
- Use low–dose-rate pulsed fluoroscopy.
- Use last image hold instead of spot fluorographic images to record the study and to plan technique.
- Minimize exposure from digital subtraction angiography (DSA) by using as low a frame rate as possible and by limiting the number of images to the smallest number necessary to achieve the diagnostic/therapeutic goal. It may be possible to substitute fluoroscopic loops for DSA when the higher image quality provided by DSA is not clinically needed.

J Vasc Interv Radiol 2012; 23:19–32

What to consent patient for in terms of adverse outcomes

Table 1. Deterministic Radiation Effects at Different Stages of Gestation (9,14,15,22,25,26,28–32)

Stage of Gestation (wk)	Possible Radiation Effect	Dose Characteristic	Estimated Threshold Dose (mGy)
3–4	Most sensitive period for the induction of embryonic death	Minimum lethal dose (from animal studies)	100–200
4–8	Embryo is also predisposed to the induction of major malformations and growth retardation	Minimum lethal dose (from animal studies)	250 (at 18 d), >500 (at >50 d)
		Minimum dose for growth retardation	200–500
8–15	Most sensitive period for irreversible whole-body growth retardation, microcephaly, and severe mental disability	Minimum dose for growth retardation	250–500
		Threshold for severe mental disability	60–500
		Decrease in IQ can occur at lower doses	~100
		Microcephaly	≥20,000
16-Term	Higher exposures can produce growth retardation and decreased brain size and intellect, although the effects are not as severe as occurs from similar exposures during midgestation	Minimum lethal dose (from animal studies)	>1,500
		Minimum dose for severe mental disability	>1,500
		Decrease in IQ can occur at lower doses	>100

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Anaesthesia/Sedation

Anesthesia was also consulted to see the patient prior to the intervention.

They agreed to perform conscious sedation on the patient during the procedure, and would follow the patient to ensure appropriate post-procedural pain management.

In essence, opiate use was recommended, though its use should be limited to minimize neonatal dependence and withdrawal. NSAID use was to be avoided.

Prophylactic Vaccinations

Infectious Diseases was consulted to determine whether and when the patient should receive prophylactic asplenia vaccinations, should inadvertent splenic infarction occur post-procedure.

Their recommendation was that the vaccinations, consisting of PPV-23, HiB, and meningococcal vaccines, be given 2 weeks prior to the planned date of the procedure.

None of the vaccines are considered contraindicated in pregnancy[3].

References

1. Ha JF, Phillips M, Faulkner K. Splenic artery aneurysm in pregnancy. *Eur J Obstet Gynecol Reprod Biol.* 2009 Oct; 146(2):233-7.

2. Dauer LT, Thornton RH, Miller DL, Damilakis J, Dixon RG, Marx MV, Schueler BA, Vano E, Venkatesan A, Bartal G, Tsetis D, Cardella JF. Radiation management for interventions using fluoroscopic or computed tomographic guidance during pregnancy: A joint guideline of the Society of Interventional Radiology and the Cardiovascular and Interventional Radiological Society of Europe with endorsement by the Canadian Interventional Radiology Association. *J Vasc Interv Radiol.* 2012; 23:19-32.

3. Guidelines for vaccinating pregnant women, Centers for Disease Control and Prevention.
   Electronic access: *www.cdc.gov/vaccines/pubs/preg-guide.htm*