AMIC NEWS

CONTRAST REACTIONS

Contrast reactions are less common today due to the change to nonionic low-osmolality contrast agents.

The majority of reactions are non-life threatening and only require observation. However, serious and potentially life-threatening reactions do occur and all medical personnel who deliver or utilize contrast agents should be well versed in recognizing and treating these reactions.

There are two distinct categories of reactions: physiologic and allergic-like. These are also further broken down into severity: mild, moderate, and severe.

Allergic-like or anaphylactoid reactions are referred to as "allergic-like" rather than "allergic" because the true mechanism is unknown and they differ in immunologic response from a true allergy but have similar presentations, resulting from histamine release. Allergic-like reactions are typically independent of dose and concentration above a known certain threshold. Contrarily, physiologic reactions are typically related to specific molecular attributes which leads to chemotoxicity or osmotoxicity and are frequently dose/concentration dependent. The distinction between these two is important because a history of allergic-like response is an indication for corticosteroid premedication. Corticosteroid premedication is not indicated with history of prior physiologic response and will not prevent future physiologic response.

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CONTRAST REACTIONS

Continued.

A summary of these reactions broken down by category is listed below. Recognizing the type and severity of reactions is essential for prompt and effective management of symptoms.

MILD

Signs and symptoms are self-limited without evidence of progression. Mild reactions include:

Allergic-like
- Limited urticaria/puritis
- Cutaneous edema
- Limited “itchy”/“scratchy” throat
- Nasal congestion
- Sneezing/conjunctivitis/rhinorrhea

Physiologic
- Limited nausea/vomiting
- Transient flushing/warmth/chills
- Headache/dizziness/anxiety/altered taste
- Mild hypertension
- Vasovagal reaction that resolves spontaneously

MODERATE

Signs and symptoms are more pronounced and commonly require medical management. Some of these reactions have the potential to become severe if not treated. Moderate reactions include:

Allergic-like
- Diffuse urticaria/puritis
- Diffuse erythema, stable vital signs
- Facial edema without dyspnea
- Throat tightness or hoarseness without dyspnea
- Wheezing/bronchospasm, mild or no hypoxia

Physiologic
- Protracted nausea/vomiting
- Hypertensive urgency
- Isolated chest pain
- Vasovagal reaction that requires and is responsive to treatment

SEVERE

Signs and symptoms often life threatening and can result in significant morbidity/mortality if not appropriately recognized and managed.

Allergic-like
- Diffuse edema, or facial edema with dyspnea
- Diffuse erythema with hypotension
- Laryngeal edema with stridor and/or hypoxia
- Wheezing/bronchospasm, significant hypoxia
- Anaphylactic shock (hypotension + tachycardia)

Physiologic
- Vasovagal reaction resistant to treatment
- Arrhythmia
- Convulsions, seizures
- Hypertensive emergency

In all cases of suspected contrast reaction, the in-house radiologist should be notified to further assess the patient. In cases of suspected severe reaction, a rapid response should be called then notify the in-house radiologist. While the physician evaluating the patient should primarily dictate medical management of the patient it is important for all staff to be familiar with treatment strategies for each type of reaction. This will not only lead to more effective and swift management but also reduce the risk of medical errors in a chaotic situation. Below is a concise list of treatments for the most common and significant reactions.

Urticaria	• d/c injection and observe pt 30-60 min • No tx needed in most cases • If Sx: Benadryl 25-50mg PO or IM • Severe/disseminated = Epi + RR
Facial or laryngeal edema	• Oxygen 6-10L/min + mask • Epi + RR
Bronchospasm	• Oxygen 6-10L/min + mask • Albuterol inhaler 2-3 puffs MDI • If unresponsive to MDI; Consider Epi + RR
Hypotension with tachycardia	• Elevate legs • Oxygen 6-10L/min + mask • Call RR • Consider large volume fluids (LR or NS) • EPI
Hypotension with bradycardia	• Elevate legs • Oxygen 6-10L/min + mask • Call RR • Consider high volume fluids (LR or NS) • If poorly responsive, consider ATROPINE
Pulmonary edema	• Oxygen 6-10L/min + mask • Call RR • Consider Lasix 20-40mg IV slowly; possibly morphine
Severe hypertension	• Oxygen 6-10L/min + mask • RR + 10mg Labetolol IV
Seizure or convulsion	• Turn on side to avoid aspiration • Oxygen 6-10L/min + mask

Drugs:
Epinephrine: 0.1-0.3mg of Epi 1:10,000 IV given slowly (*cardiac risk)

Atropine: 0.5-1.0mg IV given slowly – up to 3.0mg

Dr. Aaron Frenette

Several early non-invasive steps can be taken early by the technician or nursing staff while waiting for additional support such as patient positioning (elevating legs with hypotensive patients) or administration of oxygen is almost always beneficial and aids to help reduce anxiety in patients even those with normal oxygen saturation levels. Anxiety has been shown to exacerbate reactions, particularly physiologic responses. Staff can further alleviate patient anxiety by calmly explaining the situation and what steps are being taken.

Ultimately, contrast reactions are a rare occurrence but should be easily and readily recognized by any staff involved in contrast administration. This will ensure safe and effective care of our patients. For a more comprehensive review of reactions and treatments you can visit the ACR website for their most up to date manual: https://www.acr.org/-/media/ACR/files/clinical-resources/contrast_media.pdf

ASPECTS

(Alberta Stroke Program Early CT Score)

The Alberta Stroke Program Early CT Score (ASPECTS) is a scoring method used on non-contrast CT head or MRI examinations to evaluate early ischemic changes from acute middle cerebral artery territory infarcts. The scale goes from 0 to 10 with a score of 10 being normal. A score of 0 suggests extensive middle cerebral artery infarction and correlates inversely with the National Institutes of Health Stroke Scale (NIHSS), which goes from 0 to 42 with a score of 0 corresponding to no stroke symptoms.

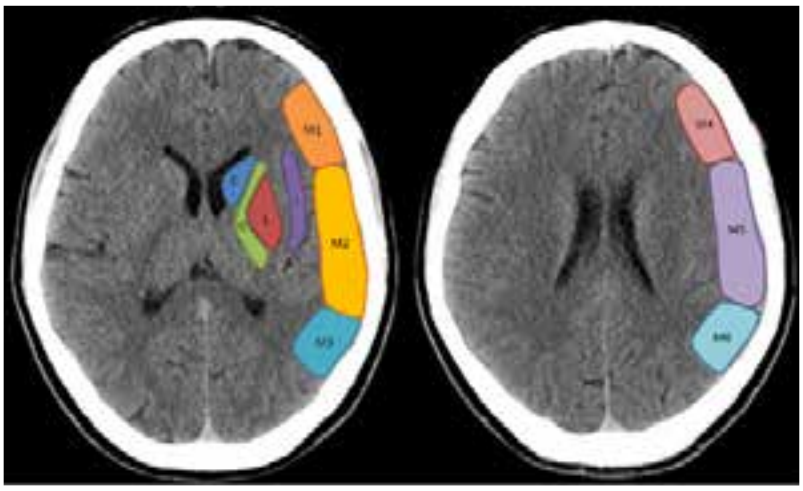
The areas include :

- Caudate
- Putamen
- Internal capsule
- Insular cortex
- M1: “anterior MCA cortex,” corresponding to frontal operculum
- M2: “MCA cortex lateral to insular ribbon,” corresponding to the anterior temporal lobe
- M3: “posterior MCA cortex,” corresponding to the posterior temporal lobe
- M4: “anterior MCA territory immediately superior to M1”
- M5: “lateral MCA territory immediately superior to M2”
- M6: “posterior MCA territory immediately superior to M3”

The radiologist utilizes the axial images from the non-contrast CT where there is loss of grey-white differentiation (early ischemic changes) or restricted diffusion on MRI to calculate the score. The scoring system involves segmental estimation of the middle cerebral artery vascular territory at the level of the basal ganglia and the supraganglionic level (corona radiata level). One point is deducted from the score of 10 for every area affected.

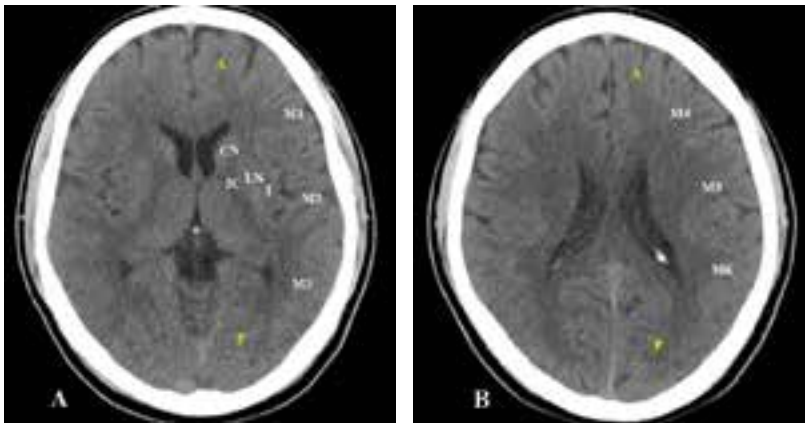
MCA Alberta stroke program early CT score (ASPECTS)

Basal ganglia level **Corona radiata level**



C: Caudate; IC: internal capsule; L: lentiform nucleus; I: Insular Cortex.

Case courtesy of Dr Osamah A. A. Alwalid, Radiopaedia.org, rID: 7 2706



Case courtesy of Dr Subash Thapa, Radiopaedia.org, rID: 40018

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Barber PA, Demchuk AM, Zhang J et-al. Validity and reliability of a quantitative computed tomography score in predicting outcome of hyperacute stroke before thrombolytic therapy. ASPECTS Study Group. Alberta Stroke Programme Early CT Score. Lancet. 2000;355 (9216): 1670-4.

Clinical Use

ASPECTS is an easily applied method of evaluation in the acute stroke setting on imaging, and it becomes even more helpful in the situation where perfusion imaging cannot be performed. A lower ASPECTS score correlates with a more unfavorable outcome with increased risk of symptomatic intracranial hemorrhage while a higher score correlates with a more favorable outcome.

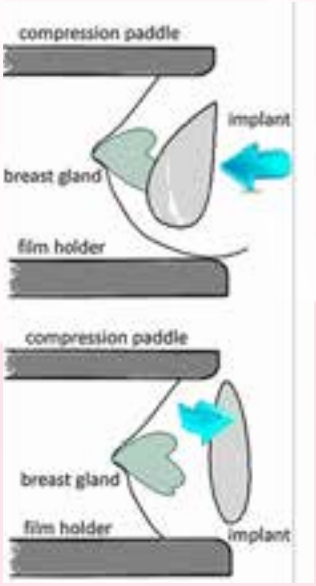
ASPECTS also helps to guide reperfusion treatment options. Initial studies on ASPECTS described it as a predictor of functional outcome and symptomatic intracranial hemorrhage after IV-thrombolysis with a threshold of ≤7 suggested to identify patients at high risk. Additional subsequent studies have demonstrated a more linear relationship between ASPECTS and functional outcome. It has also been shown that mechanical thrombectomy is beneficial over IV-thrombolysis alone in patients with non-contrast CT ASPECTS scores of 6-10.

As with any standardized scale, ASPECTS has its limitations, but it is at least worthwhile for the radiologist and referring clinicians to be familiar with as it provides a useful standardized method of communicating results and helps direct treatment in acute stroke care.

Dr. Kyle Werth

IMAGING OF BREAST IMPLANTS *and implant related complications*

The augmented breast can have a widely variable appearance and it is important to recognize the spectrum of variations in normal implant construction and their associated complications. Breast implants consist of a polymer shell filled with silicone or saline. Saline implants have a valve for volume adjustment while silicone implants do not. Implants can be placed prepectoral or retropectoral. The benefit of placing implants behind the pectoralis muscle include decreased incidence of capsular contracture and improved visibility of the breast on mammography.



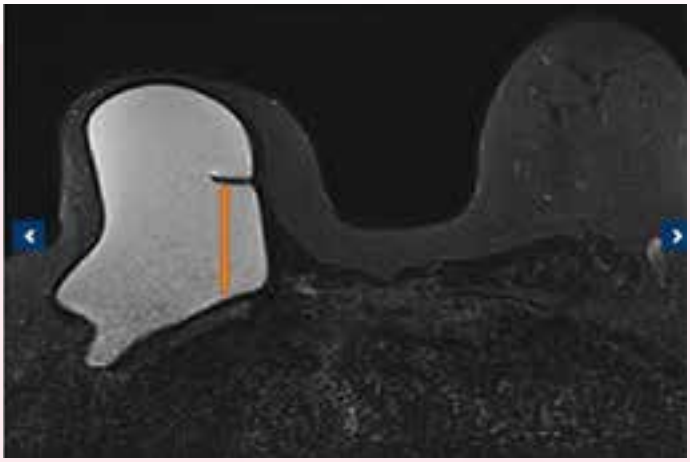
Regardless of the implant type annual screening mammography is recommended for women over the age of 40. To see as much breast tissue as possible, women with implants have 4 extra mammographic views (2 on each breast) obtained in addition to the standard 4 views taken during screening mammogram. This results in increased radiation dose for women with implants. The extra views are called implant displaced views in which the implant is pushed posteriorly against the chest wall and the breast tissue is pulled forward over it and then compressed. This allows for better imaging of the anterior part of the breast. The implant displaced views are more challenging to do and can be more uncomfortable for the patient. Very rarely, an implant can rupture during the process of obtaining a mammogram.

IMAGING OF BREAST IMPLANTS

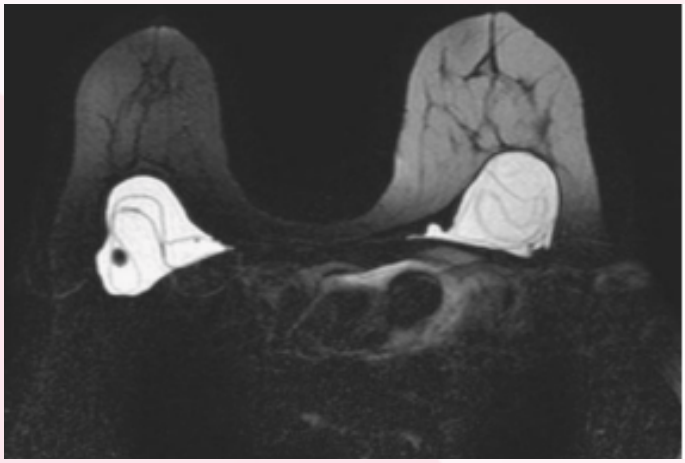
Continued.

Early Implant complications include those that occur in the immediate post-surgical period including fluid collections that develop around the implant and infections. When small postoperative seromas or peri-implant fluid collections form these are considered normal and have a favorable prognosis. They most likely represent a reactive inflammatory response related to the implant. Large or rapidly enlarging fluid collections/seromas can be painful, cause cosmetic asymmetry, or increase risk of infection. The majority of implant related infections are peri-operative in cause. Delayed infections are less common and usually related to systemic infections. Symptoms of implant infection include redness, breast swelling, discharge, fever, and pain. The presence of a complex fluid collection on ultrasound or MRI may suggest infection in the appropriate clinical setting. Fluid collections can be aspirated under ultrasound guidance and sent for cultures to help guide treatment.

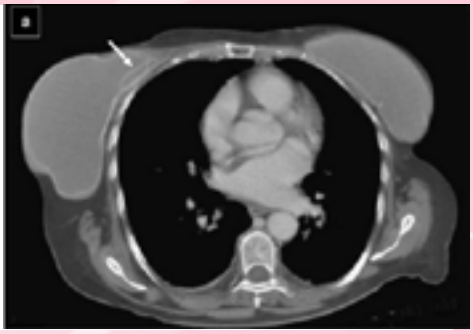
Delayed complications of breast implants include contractures, implant rupture, and gel bleed. Capsular contractures are the most common delayed complication. It is related to development of scar tissue around the implant which leads to cosmetic deformity. Radial folds are frequently seen in patients with capsular contracture. These can also been seen in the normal implant and are not to be confused with implant rupture. Calcium can deposit around the rim of the implant capsule and can sometimes be palpated. Implant rupture is another common complication which typically occurs 10-15 years after implant placement. Most ruptures have no known traumatic event and the incidence of rupture increases with implant age. The average incidence is about 2 implant ruptures per 100 implant-years with an estimated probability of being intact after 5 and 10 years of implantation of 98% and 83-85% respectively.[1] When a saline implant ruptures it is usually easily detected clinically due to implant volume loss. Silicone implant rupture is more difficult to identify clinically but may present as palpable nodules, asymmetry, or breast tenderness. There are 2 type of silicone implant rupture, intracapsular and extracapsular. Intracapsular rupture is when there is a defect in the implant shell allowing leakage of silicone from the implant but this it still contained within the fibrous capsule the body forms around the implant. When the implant collapses this results in a characteristic appearance on MRI called the linguini sign.



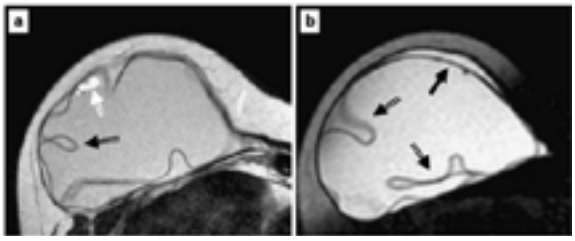
A 49-year-old woman with h/o right breast cancer treated with mastectomy and unilateral implant reconstruction. Axial STIR image demonstrates a radial fold (orange arrow) at the medial aspect of the intact right breast silicone implant.



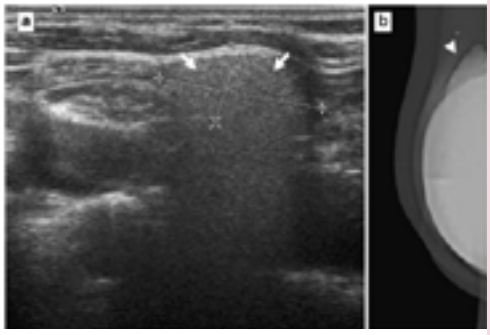
Magnetic resonance imaging scan of a woman with bilateral ruptured implants. Typical "linguine sign" within implants representing collapsed implant shell.



Unilateral implant rupture. (a) Axial CT Scan shows small high-density lines within the silicone gel in the right implant, suggestive of collapsed rupture *(arrow)*. (b) Axial silicone-excited MRI sequence confirmed intracapsular rupture, showing hypointense wavy lines at the posterior margin of the right implant ("linguine sign") and subcapsular line at the anterior margin *(arrows)*. Normal infoldings in the left implant *(arrowhead)*.



MRI of a woman with intracapsular rupture of a single-lumen silicone implant. (a) Axial T2-weighted turbo spin-echo and (b) axial silicone-excited sequence. The study shows a hypointense subcapular line at the anterior margin of the implant *(solid arrow)*; the "teardrop sign" and "keyhole sign" are also present *(open arrows)*. Focal change in signal at the anterior margin of the implant *(white open arrow)* can also be observed.



Extracapsular silicone implant rupture in a 52-year-old woman with a history of breast cancer who presented with a palpable lesion in the supraclavicular right region. Mammogram shows an irregular lump from the implant *(arrowhead)* and ultrasonography demonstrates the presence of a nodular lesion with typical inhomogeneity (the "snowstorm sign") at the posterior margin, suspicious for lymph node containing silicone.

If the implant ruptures but the shell has not completely collapsed the keyhole sign on MRI may be seen where there is capsular infoldings related to partial collapse. Extracapsular rupture occurs when silicone extends outside of the body's fibrous capsule. This is less common than intracapsular rupture. On ultrasound extracapsular silicone can be seen as deposits of silicone within the breast tissue or lymph nodes which give a characteristic "snowstorrm" appearance. On MRI extracapsular silicone is seen as a high signal intensity deposit within the breast tissue or lymph nodes. Gel bleed is another delayed complication that occurs when there is microscopic leakage of silicone through the intact implant shell. On MRI this can appear as subtle high intensity signal on both sides of the implant shell on silicone selective sequences. Several rare implant complications include the development of new or recurrent breast cancer, hematomas, and anaplastic large cell lymphoma. Implants do not increase the risk of breast cancer but they do make detection of breast cancer more difficult by mammography. Routine annual breast MRI screening is not currently recommended in patients with breast implants unless they are considered high risk. Hematomas are most commonly seen in the peri-operative period and when large can be painful and potentially required drainage. Delayed hematomas are rare and are typically caused by trauma, coagulopathy, capsular tear, cancer, or infection. On MRI or ultrasound this would appear as a complex fluid collection. Breast implant-associated anaplastic large cell lymphoma (BIA-ALCL) is a rare type of T-cell lymphoma. The risk of BIA-ALCL is higher for textured surface implants compared to smooth surface implants. There is not sufficient data to determine whether BIA-ALCL may be found more or less frequently in individuals with silicone-filled implants compared to saline-filled implants. Most patients with this condition are diagnosed after seeking treatment for implant related symptoms such as persistent peri-implant fluid collection or peri-implant mass. Lymphomatous involvement is often confined to the capsule and peri-implant fluid. Diagnosis can be made with aspiration of peri-implant fluid followed by cytologic testing.

In the asymptomatic patient annual screening mammography is recommended for women over the age of 40 with breast implants. In the symptomatic patient MRI is the most comprehensive imaging tool to evaluate implant for complications but in many cases diagnostic evaluation should start with mammography or ultrasound. The most common implant complications include contractures and implant rupture. Small peri-implant fluid collections can be normal. Large and complex peri-implant fluid collections particularly when delayed and persistent may represent infection or rarely neoplasm related complications.

Dr. Paul Gribben

References:
[1] Hölmich LR, Friis S, Fryzek JP, et al. Incidence of silicone breast implant rupture. Arch Surg 2003; 138(7): 801-6.

Imaging of
CEREBRAL VENOUS THROMBOSIS

Cerebral venous thrombosis (CVT) is a relatively rare type of stroke, affecting about 1-2% of stroke patients, often requiring a high index of suspicion and dedicated imaging techniques. Traditionally, risk factors associated with CVT included pre-existing prothrombotic conditions, oral contraceptive use, pregnancy, and malignancy. Recently, however, CVT has made the headlines due to its association with the Johnson & Johnson Ad26.COV2.S and AstraZeneca ChAdOx1 nCoV-19 COVID-19 vaccines. While still an incredibly rare complication of the vaccine, the vague clinical presentation and devastating consequences of CVT has anecdotally led to an uptick in cerebral venous imaging in radiology practices throughout the country.

Patients will most often present with new headaches or headaches with differing patterns than previous headaches. Less frequently, patients will present with encephalopathy, focal neurologic symptoms (often involving multiple vascular territories), or seizure. The most common site of thrombotic involvement is the dural venous sinuses, particularly the superior sagittal sinus and transverse sinus. The deep venous system and cortical veins are involved less often, approximately 32% and 6% of the time, respectively.

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See I, Su JR, Lale A, et al. US Case Reports of Cerebral Venous Sinus Thrombosis With Thrombocytopenia After Ad26.COV2.S Vaccination, March 2 to April 21, 2021. JAMA. 2021 Jun 22;325(24):2448-2456.

As with other suspected cerebrovascular disease, both CT and MR techniques are available. According to the ACR Appropriateness Criteria for Cerebrovascular Disease, MR venography (MRV) without and with IV contrast is rated most appropriate with a “9” rating. MRV without IV contrast and CT venography (CTV) with IV contrast both receive an “8” rating, and CT head without IV contrast (NECT) receives a “7” rating, all of which reflect a “usually appropriate” categorization. When presenting acutely, CT is often the initial choice of imaging. Findings on NECT include a hyperdense sinus or cortical vein, as well as parenchymal edema or hemorrhage related to venous infarction. On CTV, findings will include the classic “empty delta” sign, which represents a central filling defect within the venous sinus. However, given variability in clot density over time and hemoconcentration, these findings can often be obscured.

MRV technique is the optimal evaluation for CVT. Our current protocol at AMIC calls for coronal T2*-weighted sequence of the whole brain, which is exquisitely sensitive to blood products and is performed in this plane to better evaluate the superior sagittal sinus along the skull vertex. Subsequently, both axial and coronal non-contrast 2D time time-of-flight (ToF) imaging is performed to accommodate the multiplanar configuration of the dural venous sinuses and deep cerebral veins, since these sequences are sensitive to flow perpendicular to the plane of acquisition. Advantages include sensitivity to slow flow and lack of arterial enhancement. However, this sequence is prone to in-plane saturation (signal loss in the plane of imaging). Furthermore, the presence of T1-hyperintense subacute thrombus may “shine through” and mimic flow-related signal. If available, 3D phase contrast imaging can assist in these challenging situations. This sequence is sensitive to flow in all directions and is not affected by inherent signal shining through the image.

While MRV technique is the most recommended imaging modality in the initial evaluation of CVT, obtaining a brain MRI without and with IV contrast is optimal for further characterization and evaluating complications of CVT. The most encountered complications include mixed cytotoxic and vasogenic edema related to venous ischemia and hypertension and parenchymal hemorrhage. Unlike arterial strokes, these are often bilateral and multifocal. Additionally, cytotoxic edema related to venous infarcts are often reversible.

Dr. Nathan Kim

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