Patient Information

MRN xxxx8430

Gender: male

Age: 63

Chief complaint

Originally presented with severe headache and was found to have an AVM, now has intraventricular hemorrhage and altered mental status

History of Present Illness

63M, originally presented with severe headache at outside hospital, was found to have intraventricular hemorrhage from an AVM at right fronto-medial temporal lobe, and was transferred to BWH ED on 10/16 then to neurosurgery ICU under Dr. Rose Du's service on 10/17. The initial plan was AVM resection, but due to hypoxemic respiratory failure post intubation, the patient was unable to go through the procedure. His hospital stay was prolonged by development of shock, ARDS s/p tracheotomy and acute renal injury s/p hemodialysis and was transferred to MICU on 10/25. After his condition stabilized with no evidence of new AVM bleeding, he was discharged to a long-term care facility on 11/14. He came back again presented with altered mental status, was found to have new AVM rupture on CT, and was admitted to neurosurgery ICU. Craniotomy and right temporal AVM resection was not performed until 12/2 due to renal failure. On 12/6 he underwent right frontoparietal craniotomy for evacuation of a right subgaleal/epidural/subdural hematoma. Patient's condition is improving slowly and now is AO by name and place, and can follow simple commands.

Past Medical History

1. Arteriovenous malformation, medial temporal lobe
    a. Intraventricular hemorrhage
2. Chronic obstructive pulmonary disease
3. Aspiration pneumonia
4. Hypoxia
5. Acute kidney injury post hemodialysis
6. Coronary artery disease
7. Essential hypertension
8. Gastroesophageal reflux disease
9. Cholecystitis
10. Bilateral cataracts

Family History

Glaucoma-mother

Social History

Smoking tobacco use: former smoker, quitted 01/01/2001

Smokeless tobacco use: denied

Alcohol use: yes, 25.2oz/wk, 42 cans of beer/wk

Drug used: denied

Family: wife and children, supportive family who are actively involved

Travel history

None

Allergy

1. Codeine
2. Penicillin

Review of system

Per HPI, otherwise negative

Physical Examination

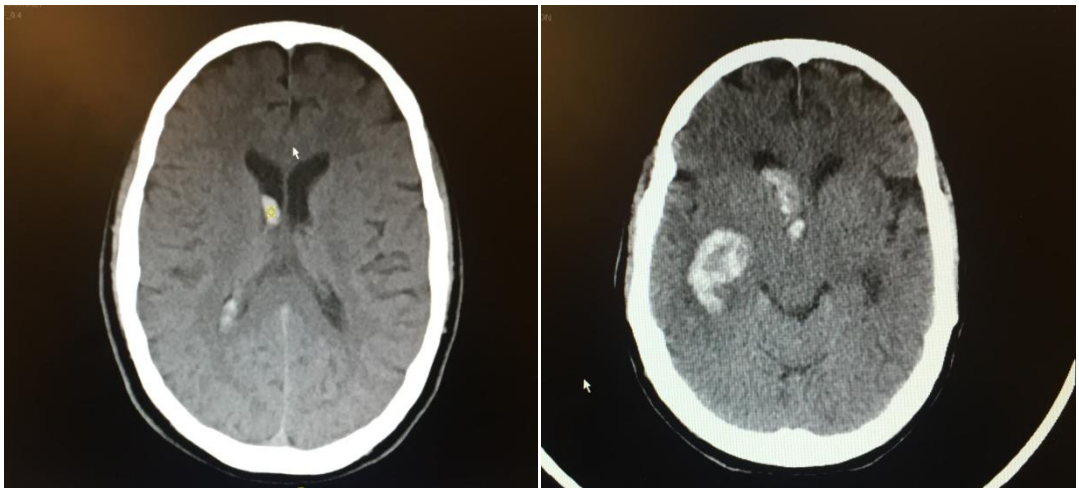
- General: intubated
- HEENT: EOMI, mucous membrane moist
- Head: normal cephalic, atraumatic
- Respiratory: normal respiratory effort, clear to auscultation bilaterally
- Heart: regular rate and rhythm, no murmurs and gallops
- Abdomen: non-distended, soft, non-tender, no rebound, guarding or masses. Bowel sounds present
- Skin: warm/dry, well perfused, no rashes
- Neurologic: easily awoken, oriented by name and place, follows simple commands
- Psychiatric: normal affect

Lab Data

CBC	11/21/2015	11/22/2015	11/24/2015
WBC	7.15	8.22	13.68
HGB	8.6	8.5	9.5
HCT	26.4	25.5	29.0

MCV	89.2	86.4	87.3
RDW	14.7	14.4	14.2
PLT	248	285	347
BAND	0.0	--	--
Basic Metabolic Panel			
Na	138	243	138
K	4.0	3.8	5.3
Cl	98	101	95
CO_2	23	22	22
BUN	31	51	34
Glucose	151	145	145
Ca^{2+}	8.0	8.4	9.1
Mg^{2+}	1.7	1.8	--
Phosphate	3.4	--	--
SGOT	--	--	22
Total Bilirubin	--	--	0.4
Albumin	--	--	3.8
PT	--	--	13.4
INR	--	--	1.0

<u>Imaging study</u>



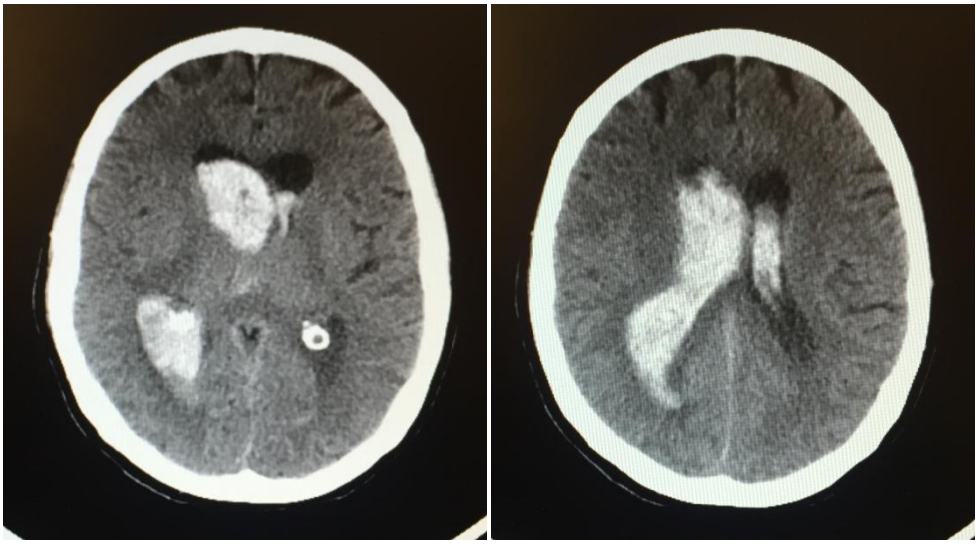


Figure 1: CT from outside hospital shows right intraventricular hemorrhage

Figure 2. 10/17 cerebral angiography: pooling of contrast indicates presence of AVM nidus at right medial temporal lobe.

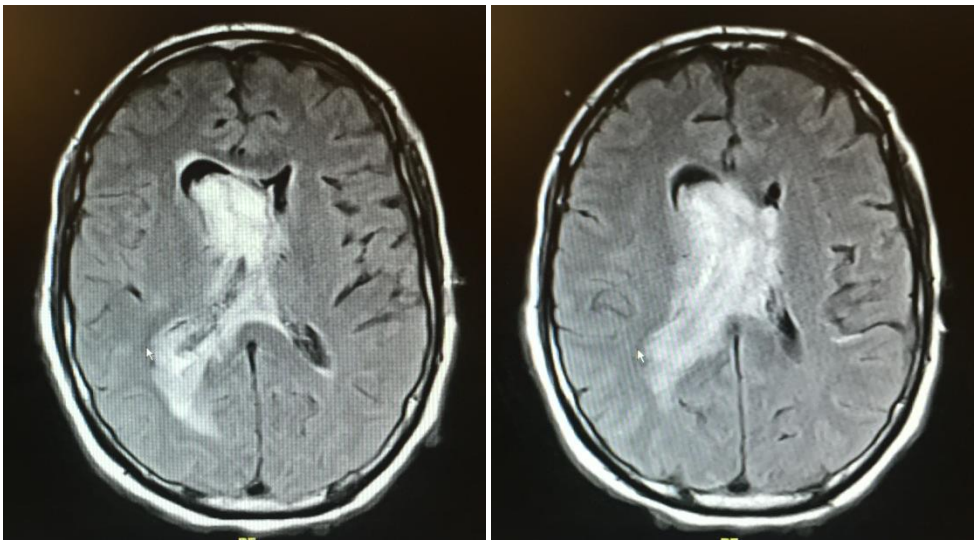


Figure 3. 11/24 nonenhanced brain MRI shows AVM rebleed and progression of right

IVH

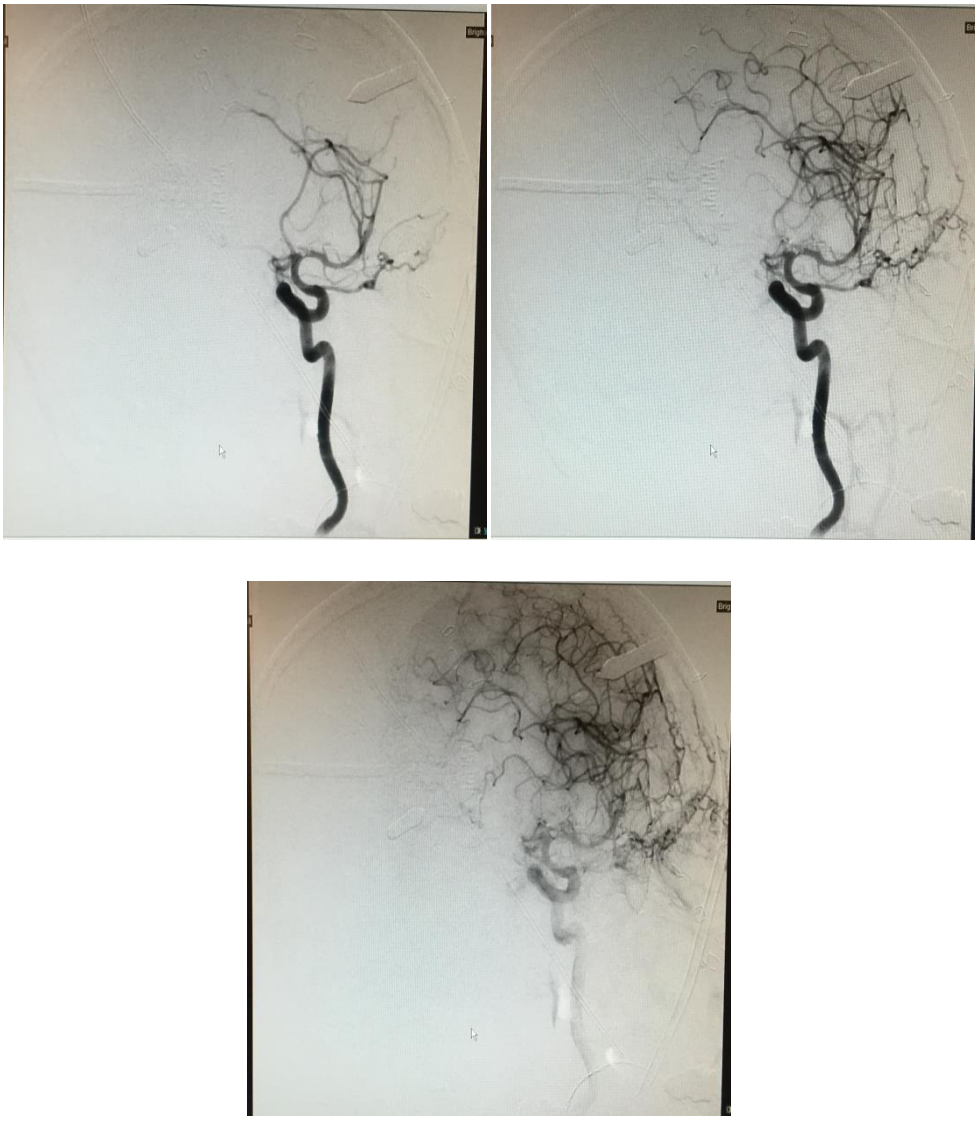


Figure 4. 12/2 Intra-operative cerebral angiography to confirm complete resection of AVM

Figure 5. 12/5 nonenhanced head CT shows brain swelling and subgaleal/ epidural/ subdural hematoma

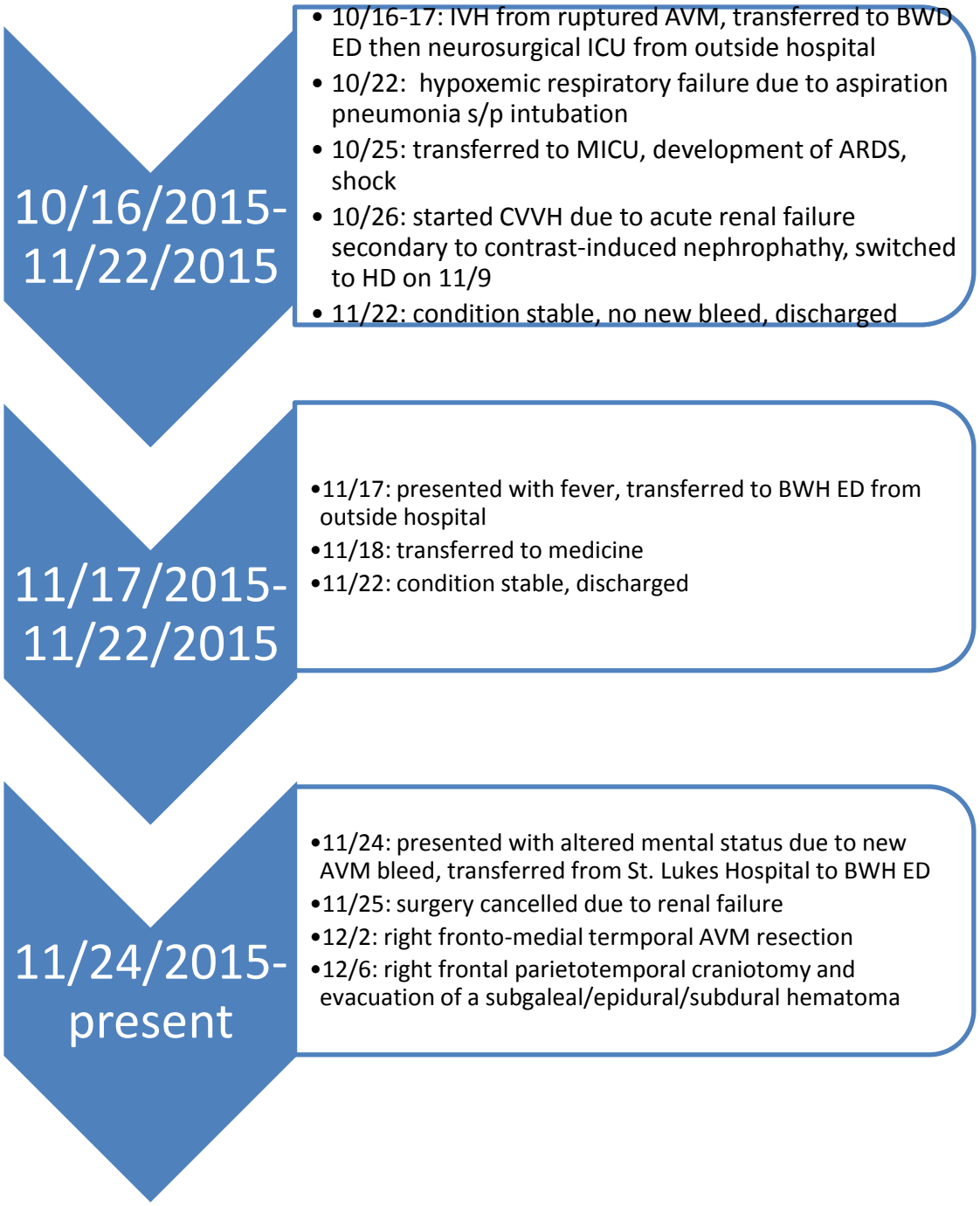
Assessment

63 years old male with previous diagnosis of Arteriovenous malformation, right fronto-medial temporal lobe and …….

Differential Diagnosis

Diagnosis has been confirmed by CT and angiography when our service received the patient.

Hospital Course



Discussion

Arterioventricular malformation (AVM) is a congenital vascular anomaly that can occur anywhere in the body, but is most commonly found in the brain and spinal cord. It is usually sporadic, although there have been reported cases of familial AVM, it has been hard to determine whether it is truly hereditary or mere coincidence. Around 0.1 percent of the population has brain AVM, and the majority is supratentorial. They account for 1-2 percent of all strokes, 3 percent of strokes in young adults, and 9 percent of subarachnoid hemorrhage. Typical presentations of brain AVM include intracranial or subarachnoid hemorrhage, epilepsy and/or seizure, headache, and focal neurological deficits. Studies have shown that the overall annual hemorrhage rate is around 3%. In particular, in patients with ruptured and untreated AVM and whose initial presentation was hemorrhage, there is an increased risk of subsequent hemorrhage. CT, MRI, and angiography are all commonly used in identifying and planning treatment for the disease, though angiography is the golden standard for diagnosis, treatment planning, and post-treatment follow up. Treatment modalities include surgical resection, stereotactic radiosurgery, and endovascular embolization, with surgery being the mainstay option.

As mentioned above, cerebral AVM has an incidence of 0.1% in population, not uncommon but not often seen in the hospital, either. This case was my first experience with cerebral AVM and I was fortunate enough to be there for the majority of his hospital course. As a student we've always been told intracranial hemorrhage can dramatically alter a person's daily functioning, and that exactly was what I saw in this patient, barely oriented and with only the ability to follow simple commands, was nowhere like what previous consult notes described him as without any neurological deficits. I was also able to witness how treatments can benefit and

harm our patients at the same time. This patient benefitted greatly from advanced imaging technology; the physicians could visualize the exact location of the nidus and the major feeding arteries and draining veins with angiography. However, the patient suffered from AKI as a result of contrast-induced nephropathy (though shock during his first hospitalization may also be a contributing factor), and his surgery had to be postponed due to renal failure and ongoing hemodialysis. Luckily for him and the team, his renal condition was slowly nursed back to his baseline, and the neurosurgical team was able to proceed with a successful microsurgical resection of his right temporal AVM, which I was fortunate enough to observe the entire procedure. This experience had me wondering about the efficacy surgical resection compared to other alternatives in treating AVMs.

Canals et al. in 2013 classified temporal AVMs into 5 subtypes based on anatomical locations. According to their study, lateral AVM is the easiest to approach surgically, and the remaining four require a more complicated planning. The data showed that in selected patients, surgical results are generally good regardless of anatomical subtypes. This falls within the general consensus that surgical resection of cerebral AVM, particularly temporal ones, is still the mainstay of treatment. Another publication by Gross and Du in 2012 compared the results of microsurgical and radiosurgical resection of cerebral AVMs. In low grade AVMs, diameter <3cm, or with mainly superficial draining veins, obliteration was 91% with microsurgical resection. The obliteration rate even reached 94% in AVMS >3cm. The types of patients that would undergo stereotactic radiosurgeries (SRS) were those with larger and/or deeper AVMs, which can be challenging and surgically suboptimal, with obliteration rate of 81%. Overall, if feasible, microsurgery provides an immediate therapeautic effect with high obliteration rate of 91%, whereas patients who underwent SRS had less promising results.

After reviewing current literature, surgery, especially microsurgery now with medically advanced technology available, remains as first line treatment in cerebral AVM. Although SRS provides an alternative for patients who may not be suitable to undergo surgery, whether it is his general condition or the characteristics of the AVM itself, the results are still not as satisfactory as microsurgery. Fortunately, as Gross and Du pointed out, the future development and growth of endovascular embolization may provide another option of treatment for AVMs in the future.

Reference

1. Uptodate: brain arteriovenous malformation http://www.uptodate.com/contents/brain-arteriovenous-malformations?source=search_result&search=brain+avm&selectedTitle=1~19
2. Canals, Andreu Gabarrós, Ana Rodríguez-Hernández, William L. Young, and Michael T. Lawton. "Temporal Lobe Arteriovenous Malformations: Anatomical Subtypes, Surgical Strategy, and Outcomes." *Journal of Neurosurgery* 119.3 (2013): 616-28.
3. Gross, Bradley A., and Rose Du. "Surgical and Radiosurgical Results of the Treatment of Cerebral Arteriovenous Malformations." *Journal of Clinical Neuroscience* 19.7 (2012): 1001-004.