



Augusta Code Subarachnoid Hemorrhage

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Short Communication

Subarachnoid hemorrhage (SAH) is one of the most common and life-threatening neurosurgical emergencies. Annually 9.7-14.5/100,000 people suffer from a SAH and 10-15% of patients die prior to presentation to the hospital [1]. For those who survive the initial rupture, early re-bleeding is a major cause of morbidity [2]. The most crucial time period to prevent re-bleeding is the first three to six hours [3]. Prompt evaluation and treatment of patients who present to the hospital with SAH is crucial.

The first thing, upon presentation of patients with SAH is to manage their airway, breathing and circulation. Subsequently, a computed tomography and computed angiography (CT/CTA) of the head is obtained. In an ideal setting with unlimited resources and multiple providers who subspecialize in vascular neurosurgery, patients who present with SAH should be taken emergently to a hybrid operating room (OR). There an external ventricular drain (EVD) should be placed using image guidance for patients who present with a Hunt and Hess score greater than and equal to three. Immediately thereafter a diagnostic cerebral angiogram and coiling of the ruptured cerebral aneurysm should be completed. If unable to secure the aneurysm with an endovascular procedure a craniotomy for aneurysm clipping should be performed.

Currently at our institution, as part of a quality improvement project, we are standardizing the evaluation and management of patients with SAH. The goals of this project are:

1. Conducting a neurosurgical evaluation, obtaining a CT/CTA of the head, intubating the patient, placing an arterial line

and an EVD all should be completed within two hours of the patient's arrival to the emergency department (ED).

2. A diagnostic cerebral angiogram and coil embolization of the ruptured cerebral aneurysm is started within six hours of the patient's arrival to the ED.

3. If clipping of the aneurysm is necessary, it should be performed once the diagnostic cerebral angiogram is completed. In order to minimize delays the diagnostic cerebral angiogram should be performed in a hybrid OR where there is capability for both endovascular and open vascular neurosurgical procedures. The surgical procedure should start within six hours following angiography.

The "Augusta Code Subarachnoid Hemorrhage" should be initiated if there is clinical suspicion that the patient might have SAH. The code will activate multiple interdisciplinary teams the role of which is discussed below. If the CT scan of the head shows SAH a CTA will be completed. Traumatic related SAH is excluded from this protocol. If the imaging findings are negative for SAH the code will be de-activated.

- a) **Neurosurgical team:** The neurosurgical team is the primary team involved in the care of patients suffering from SAH. They perform initial patient evaluation, order preoperative labs and initiate intensive care unit admission orders. If the patient is on antiplatelet medication and/or anticoagulation medication appropriate reversal is administered. An EVD is placed in the ED for patients with Hunt and Hess score greater than or equal to three.

The supplies required for the EVD placement are stored in a cart in the ED. The neurosurgical team should ensure that each team adheres to their role and also serve as a link between all the teams.

b) **Emergency department team:** The ED provider should stabilize the patient. This includes ensuring that the head of the bed is elevated to thirty degrees and that patient's airway, breathing and circulation are secured. If the clinical situation permits patient should be intubated after returning from imaging of the head and after the neurosurgery team obtains a neurological exam. If the patient is unable to protect his/her airway and needs emergent intubation prior to assessment by the neurosurgery team a short acting paralytic agent should be used. The ED nurse should draw laboratory tests, transport the patient to the scanner and administer appropriate blood products and/or blood pressure medications.

c) **Pharmacy team:** The pharmacy team arrives at the bedside with medications including those needed for intubation, pre-operative antibiotics, hyperosmolar therapy, sedative drips, anticoagulant reversal agents and sugammadex.

d) **Radiology team:** The radiology team prioritizes scanning patients with SAH and reading the imaging findings.

e) **Operating room team:** The OR team prepares the OR, equipment and personnel in order to proceed with the procedure.

With the implementation of this simple standardized process the orderly evaluation and treatment of patients with SAH will be achieved. The ultimate goal is to prevent re-bleeding. We are also hoping that this protocol can be used by other institutions around the world as a guide for the timely evaluation and management of patients with SAH.

Conflicts of Interest

The authors have no personal, financial, or institutional interest in any of the drugs, materials, or devices described in this article.

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