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Essay

Anesthesia for the surgical treatment of cerebral aneurysms☆

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ABSTRACT

Although most cerebral aneurysms are asymptomatic and discovered incidentally, their rupture often results in significant morbidity and mortality. The anesthesiologist may become involved in surgical clipping of aneurysms either before aneurysm rupture or after subarachnoid hemorrhage. After subarachnoid hemorrhage, a multisystemic preoperative evaluation is mandatory because both neurological complications (elevated intracranial pressure, rebleeding, hydrocephalus, vasospasm) and non-neurological complications (respiratory insufficiency, cardiac dysfunction, electrolyte abnormalities, endocrine disturbances) might influence anesthetic management. Besides being prepared for potential sudden profuse bleeding, the anesthesiologist caring for craniotomy for aneurysm clipping should follow four main principles. First, acute increase in the aneurysm transmural gradient (mean arterial pressure minus intracranial pressure) should be avoided to prevent rupture or rebleeding. Second, the cerebral perfusion pressure should be maintained with euvolemia and vasopressors to avoid brain ischemia caused either by brain retractors or temporary clipping of the feeding vessel. Third, surgical exposure should be optimized by providing brain relaxation with normal cerebral oxygenation, normal ventilation or transient hyperventilation, appropriate anesthetic choice, mannitol and perhaps lasix, and occasionally cerebrospinal fluid drainage. Fourth, early emergence is favored to allow recognition of potentially reversible complications. By being vigilant and achieving these goals, the anesthesiologist will contribute to optimal patient outcomes. The following article provides information to guide the anesthesiologist in optimal management of surgical clipping of aneurysms.

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Anestesia para el Tratamiento Quirúrgico de Aneurismas Cerebrales

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RESUMEN

A pesar de que la mayoría de los aneurismas cerebrales son asintomáticos y se describen incidentalmente, su ruptura suele resultar en una morbilidad y mortalidad significativas Por lo tanto, el anestesiólogo pudiera intervenir realizando un clipaje quirúrgico del aneurisma, bien sea de manera electiva o posterior a una hemorragia subaracnoidea. Luego de una hemorragia subaracnoidea es indispensable hacer una evaluación preoperatoria sistémica porque el manejo anestésico puede verse afectado tanto por las complicaciones neurológicas (presión intracraneal elevada, repetición de la hemorragia, hidrocefalia, vasoespasmo) y complicaciones no neurológicas (insuficiencia respiratoria, disfunción cardíaca, anomalías electrolíticas, alteraciones endocrinas). Además de estar preparado para una hemorragia profusa súbita, el anestesiólogo a cargo de una craneotomía para clipaje de un aneurisma debe adherirse a cuatro principios fundamentales. Primero, debe evitarse el incremento agudo en el gradiente transmural del aneurisma (presión arterial media menos la presión intracraneal) para impedir una ruptura o recurrencia de hemorragia. Segundo, la presión de perfusión cerebral debe mantenerse con euvolemia y vasopresores para evitar isquemia cerebral, bien sea con separadores cerebrales o clipaje temporal del vaso nutriente. Tercero, debe optimizarse la exposición quirúrgica con relajación cerebral mediante oxigenación y ventilación cerebral normal, selección apropiada del anestésico, manitol y tal vez lasix, drenaje de líquido cefalorraquídeo o hiperventilación transitoria. Cuarto, se recomienda el despertar temprano de la anestesia para reconocer precozmente las complicaciones potencialmente reversibles. Siendo vigilantes y logrando estas metas, el anestesiólogo contribuirá al logro de desenlaces óptimos para el paciente. El siguiente artículo ofrece información para orientar al anestesiólogo para el óptimo manejo del clipaje quirúrgico de aneurismas.

Introduction

Cerebral aneurysms are acquired outpouchings of arteries in the subarachnoid space. They frequently develop at vascular bifurcations secondary to hemodynamic stress and turbulent flow.[1] Overall prevalence of unruptured aneurysms is estimated to be 3.2%. Prevalence is higher in women and in patients with polycystic kidney disease or a positive family history of intracranial aneurysms or subarachnoid hemorrhage.[2] Multiple aneurysms are found in 20–30% of the patients. Most cerebral aneurysms (80–85%) are located in the anterior circulation and are more prone to rupture when larger than 7 mm.[3–5] The incidence rate of aneurysmal subarachnoid hemorrhage is approximately 10 per 100,000.[3,6] Subarachnoid hemorrhage is fatal in >25% of the cases and >50% of the survivors have persistent neurological deficits. Early repair and aggressive management of complications have contributed to improved functional outcomes.[3] The following article provides information to guide the anesthesiologist in optimal management of surgical clipping of aneurysms.

Unruptured aneurysms

The majority of unruptured aneurysms are asymptomatic and therefore only discovered incidentally, often on investigation for headache. However, some may present with cranial neuropathy, visual loss, facial pain, motor weakness, headache, seizures, or ischemic events related to emboli. Symptomatic unruptured aneurysms are considered at higher risk of rupture and referred for intervention.[7,8] The management of asymptomatic aneurysms remains controversial. Risk of rupture needs to be balanced with risk of intervention according to both the aneurysm characteristics (site, size, natural history) and patient characteristics (age, comorbidities). The preferred intervention, surgical clipping versus endovascular treatment, is individualized according to aneurysm characteristics and treatment team preferences.[4,9–14]

Ruptured aneurysms

After aneurysmal rupture, arterial blood flows freely into the subarachnoid space spreading into cerebrospinal fluid. Intracranial pressure suddenly reaches values equal to arterial pressure.[1] This explains the characteristic sudden and intense headache often described as “the worst headache of my life”. In those who do not survive, intracranial pressure remains equal to or above arterial. Other manifestations include loss of consciousness, seizures, stiff neck, photophobia, nausea and vomiting, focal neurological deficits or cranial nerve palsies.[1,3] It is estimated that up to 40% of the patients report a milder sentinel headache before the overt subarachnoid hemorrhage, which may represent a warning leak.[3] Many grading scales for subarachnoid hemorrhage have been proposed, but three (Tables 1–3) are mainly used in clinical practice.[1,15–18]