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Review

Anesthesia for minimally invasive neurosurgery☆

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ABSTRACT

Introduction: Advances in imaging, computing and optics have encouraged the application of minimally invasive surgical approach to a variety of neurosurgical procedures. The advantages include accurate localization of lesions usually inaccessible to conventional surgery, less trauma to healthy brain, blood vessels and nerves, shorter operating time, reduced blood loss, and early recovery and discharge. Nevertheless minimally invasive neurosurgical (MIN) procedures still have potential intra- and post-operative complications that can cause morbidity and mortality.

Objectives: The aim of this study was to review and analyze published literature describing experiences in the anesthetic management of the most commonly performed MIN procedures.

Materials and methods: Neurosurgical and neuroanesthesia literature (1990–2013) was reviewed and description of anesthetic technique/management and perioperative morbidity/mortality was reported. We also compared the different authors' experience with MIN procedures.

Results: The neurosurgical literature dealing with MIN has expanded, but there are few references in relation to anesthetic management. Anesthesia goals remain the same: careful pre-operative assessment and planning, and meticulous cerebral hemodynamic control to ensure adequate cerebral perfusion pressure. The degree of postoperative care depends on local practice, patient factors and postoperative brain imaging.

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Anestesia para Neurocirugía Mínimamente Invasiva

Palabras clave:
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RESUMEN

Introducción: Los avances en la formación de imágenes, la computación y la óptica han alentado la aplicación del enfoque quirúrgico mínimamente invasivo a una variedad de procedimientos neuroquirúrgicos. Las ventajas incluyen la localización exacta de las lesiones generalmente inaccesibles a la cirugía convencional, menos trauma al cerebro sano, vasos sanguíneos y nervios, más corto el tiempo de funcionamiento, la reducción de la pérdida de sangre, la recuperación temprana y el alta. Sin embargo los procedimientos neuroquirúrgicos mínimamente invasivos (NMI) todavía tienen potencial complicaciones intra y post-operatorias que pueden causar morbilidad y mortalidad.
Objetivos: El objetivo de este estudio fue revisar y analizar la literatura publicada que describe las experiencias en el manejo anestésico de los procedimientos más comúnmente realizados en NMI.
Materiales y métodos: Literatura sobre neurocirugía y neuroanestesia (1990–2013). Revisión y descripción de la técnica anestésica/gestión y morbilidad perioperatoria/mortalidad notificada. Comparación de la experiencia de los diferentes autores en procedimientos de NMI.
Resultados: La literatura sobre NMI se ha expandido, pero hay pocas referencias en relación con el manejo anestésico. Las metas anestésicas siguen siendo las mismas: la evaluación preoperatoria cuidadosa y la planificación, el meticuloso control de hemodinámica cerebral para asegurar la presión de perfusión cerebral adecuada. El grado de cuidado postoperatorio depende de la práctica local, factores del paciente y de imagen cerebral postoperatoria.

Introduction

Neurosurgical literature dealing with minimally invasive neurosurgery (MIN) has expanded, but there are few references in relation to anesthetic management. Anesthesia goals remain the same: careful pre-operative assessment, planning, and meticulous cerebral hemodynamic control to ensure adequate cerebral perfusion pressure. Patients should be monitored as if undergoing a traditional craniotomy. It is important to select an anesthetic technique which allows rapid emergence for prompt neurological assessment.[1]

The following is a summary of anesthetic and perioperative features for the most commonly performed MIN procedures, after narrative review of literature about neurosurgery and neuroanesthesia between 1990 and 2013.

Closed brain biopsy

"Closed" biopsy of the brain includes percutaneous frame-based (CT-guided with stereotactic frame), frameless (navigation-guided or stealth), and Mayfield 3-point skull pin fixation, with or without endoscopy.

Anesthetic considerations

The choice of anesthesia for closed brain biopsy depends on the surgical technique, patient characteristics and positioning. Precordial Doppler can be used to detect venous air embolism in semi-sitting position.[2] Neuronavigational procedures require a high degree of precision and patient immobility. This is easily achieved with general anesthesia and hence is the preferred technique over local anesthesia and sedation.[3,4] In contrast to routine neuroanesthesia practice where a slack brain is desired, brain shift due to a "slack" brain may lead to loss of reliability of the navigational system. Maintenance of normocarbia and the avoidance of mannitol will minimize brain displacement. If a patient fails to awaken after the procedure, a CT scan should be performed to rule out cerebral edema, hematoma, or pneumocephalus.

When local anesthesia and monitored sedation is chosen, regional nerve blocks can be applied.[5] Sedation may be required and achieved using dexmedetomidine, propofol, and/or remifentanil.[2] An invasive, or non-invasive but continuous, blood pressure recording is useful to monitor for unexpected hypertensive peaks that could facilitate bleeding.

Perioperative setting

Table 1 lists the perioperative complications associated with closed brain biopsy. The diagnostic yield, event rates, and biopsy-related mortality do not differ among the different closed biopsy techniques.[4,6]

The degree of postoperative care varies between institutions. In Purzner et al.,[7] of 244 patients who underwent a brain biopsy, 152 (62%) were selected to be outpatients; 143 patients (94.1%) were successfully discharged from the day surgery unit, 4.6% could not be discharged, and 1.3% were discharged and later readmitted (Table 2). Other centers perform a brain-imaging study before discharging patients from the postoperative care unit. Ideally, every center should have a clinical pathway that prepares and plans for closed brain