Cutting-edge advancement in pediatric neurosurgery and anesthetic implications: Robotic Stereotactic Assistance (ROSA®)

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Introduction

Robotic assisted neurosurgical procedures are increasingly utilized due to their high degree of precision and minimally invasive approach. The recently developed Robotic Stereotactic Assistance (ROSA®) system uses image guidance to assist neurosurgeons with a variety of minimally invasive procedures. However, the use of robotic assistance for neurosurgery has been infrequently reported in the pediatric population. Furthermore, the anesthetic implications and intraoperative considerations for pediatric ROSA® procedures remain to be discussed.

Case Presentation

A 16-year old 74.3 kg male with intractable epilepsy presented for right-sided depth electrode placement. General anesthesia was induced via mask induction with sevoflurane. Two large bore IVs were placed and the patient was intubated. General anesthesia was maintained with 2% sevoflurane and a remifentanil infusion ranging from 0.1 to 0.2 mcg/kg/min. The OR bed was rotated 90º clockwise, and the patient's head was placed in Mayfield pins. The ROSA® mechanical arm was extended and locked to the Mayfield frame (Figure 1). The ROSA® laser attachment then scanned the patient's facial landmarks for surface registration to plan trajectory entry sites based on uploaded CT and MR images (Figure 2). The ROSA® robotic arm then directed the neurosurgery team to twelve stereo-electroencephalography (SEEG) implantation sites on the right frontal, temporal, and insular lobes.

Following implantation of the SEEG electrodes, the depth of general anesthesia was maintained until the patient was unlocked from the ROSA® system and removed from Mayfield pins. He received a total of 1.4 mcg/kg of fentanyl, and an awake extubation was performed to establish an immediate postoperative neurological assessment. The patient was transported to the PICU in stable condition, where he was monitored for epileptic activity to localize seizure foci.

Figure 1: Rigid fixation of the patient's head to the ROSA® system

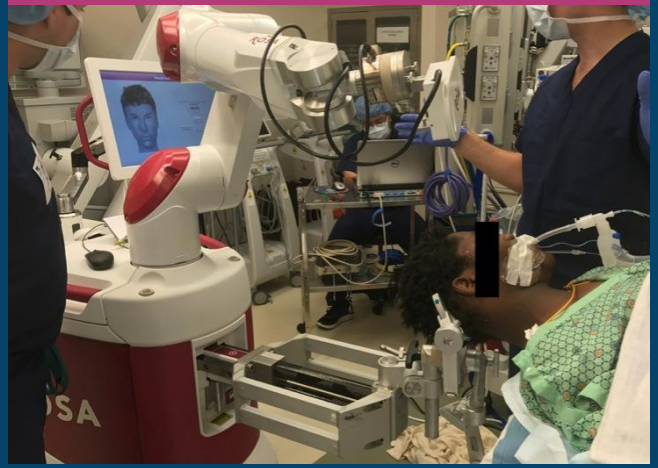
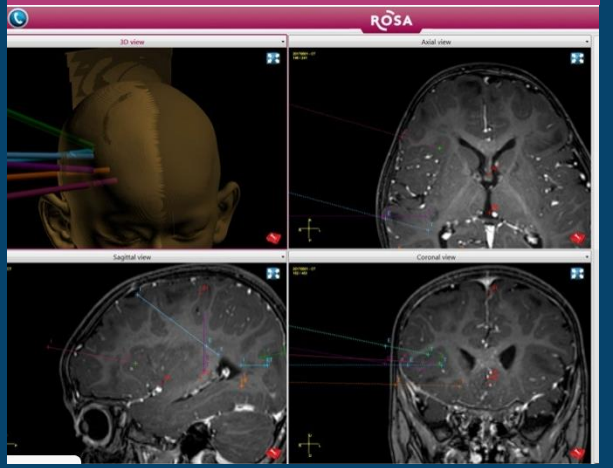


Figure 2: Planned depth electrode trajectories



Discussion

The ROSA® device allows for a safe, efficient, minimally invasive, and highly accurate image-guided approach to depth electrode placement for seizure monitoring. The combination of image guidance, as well as the stability and precision of the robotic arm, offers advantages over traditional approaches. In addition, compared to invasive monitoring such as subdural grids, SEEG allows for a more precise identification of epileptogenic foci. Due to the significance of accurate intracerebral recording of electrical activity, it is imperative that the planned trajectory of the depth electrodes correlates with their actual trajectory. Therefore, patient movement during laser surface recognition or depth electrode placement could lead to a highly inaccurate and potentially dangerous trajectory. In addition, the patient is not only fixated to Mayfield pins but is secured to a mechanical arm which is further locked to the floor via the ROSA® base. Precautions such as unplugging the OR bed control and maintaining a steady state infusion of analgesic (i.e. remifentanil infusion) will aid in mitigating these concerns. Significant blood loss complications have not been frequently reported in the literature. This patient did not have other factors increasing the risk for intraoperative blood loss, and therefore, the placement of an arterial line for invasive hemodynamic monitoring was not necessary in this case.

References 1. De Benedictis A et al. *Neurosurgical Focus* 2017;42(5): E7. 2. Gonzalez-Martinez J et al. *Neurosurgery* 2014;10(2):167-72 3. Hoshide R et al. *J Neurosurg Pediatr* 2017;20(2):125-133.