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Letter to the Editor

Optimal design of neurosurgical hybrid operating room

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A neurosurgical hybrid operating room (NHOR) is an operating theater with imaging equipment equivalent to an angiography suite (biplane imaging). It serves as a multifunctional room designed to allow the performance of neuroendovascular and open surgical procedures. Such integration requires a work environment that can support an interdisciplinary neurovascular team. NHOR offers a multitude of benefits such as eliminating the intricacies involved in caring for high-risk patients outside the operating room (OR) area, the possibility of switching between endovascular and open surgical procedures without patient transfer, and allowing imaging of the head in different positions. Notwithstanding these benefits, the workflow of NHOR can be hindered by several potential pitfalls during the design and/or operation phases.

A neurosurgical hybrid operating room provides a unique functionality through the integration of multiple systems.[2,3] The following factors should be considered during the design phase: room geometry and the location of the anesthesia, biplane, and surgery stations. Furthermore, the design should consider the number and location of storage units and OR doors, angiography control room, mobility of the OR table and main biplane monitor, and the OR staff.

The room should meet the established OR standards such as ventilation, air pressure, temperature, and humidity systems. A room with a rectangular or square shape is preferred, and the size should take into account the space required for storage units and anesthesia, biplane, and open surgery stations to eliminate the effects of crowding. The general organization of NHOR should maximize the safety and efficiency. For example, in our NHOR, the anesthesia, biplane, and open surgery stations are arranged at right angles to each other with the biplane and the open surgery stations located next to each other, which allow a quick and controlled movement of the patient between the two stations.

The OR table should have a radiolucent and floating tabletop, allowing swift and precise movements during angiography. It should also have a removable angiography console and side rails, articulated attachments for the headrest, head clamp, and navigation. Moreover, the OR table should be positioned in the center of the room and have a high degree of horizontal rotation (270–360°) to allow the transition between different stations. This degree of mobility, when combined with the size of each station, will limit the effect of crowding and provide flexibility in positioning the patient for different surgical approaches and allow access to the patient's entire body. It will also give the anesthesia team the necessary space to take the necessary steps to get the patient ready for the procedure and allow a smooth transition between the surgical and biplane stations while keeping the patient sterile draping in place.

The main biplane monitor should be mounted to the OR ceiling using a motorized arm with a high degree of mobility, allowing rotation along a circular path and the vertical axis of the monitor. This will enable the monitor to be positioned at different locations within the room, including facing the ceiling to allow the OR table to retain its freedom of movement and the anesthesia team to intervene quickly in case of emergencies. The monitor should also have the capability for linear movement (vertical and horizontal) and display of microscope images in addition to angiography.

Ashour *et al.*[1] described an NHOR design that allowed a quick transition between open surgery and angiography. The design involved rotating the A-plane to the left side of the patient and positioning the B-plane at or below the patient's waistline to allow performing open cranial procedures. The authors indicated that such a design allowed the operator access to the patient's head in a semicircle fashion and transition between the open surgery and angiography stations by linearly moving the table while keeping the patient's head in the surgical position. Although the design appears efficient but has multiple drawbacks, including limited horizontal rotation of the OR table, the location of the A-plane between the anesthesia station and the patient during open procedures, and only allowed basic surgical positions.

The NHOR should have a dedicated team (nurses and technicians) with comprehensive training in setting up the room for both neuroendovascular and open surgical procedures. Furthermore, it is preferable to have two radiology technicians, allowing concurrent management of the main angiography console and the biplane system (contrast injector and manual C-arms movement) besides monitoring the drips and retrieving necessary supplies for the procedure. Moreover, there should be protocols in place to update the staff with any modifications to the room setup or workflow.

A neurosurgical hybrid operating room is designed to allow the performance of neuroendovascular and open surgical procedures. Such integration carries the risk for several pitfalls that may deem the room inefficient. Therefore, a comprehensive design with a systematic organization and a dedicated staff is needed for optimal workflow.

Declaration of patient consent

Patient's consent not required as there are no patients in this study.

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Conflicts of interest

There are no conflicts of interest.

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