Neurointerventional Room Design - An Iterative Approach

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Background: Over the last 3 years at our institution, we have designed and built 3 neurointerventional suites that are also cardiac catheterization laboratories. These rooms were also designed for advanced cardiac catheterization procedures. The rooms were designed and constructed with multidisciplinary team from initial design to final buildout. Since these rooms were constructed in sequence rather than simultaneously, we applied the lessons learned in design and construction of preceding rooms to the design of the subsequent rooms.

Non-operating room anesthesia is known to complicate the safe delivery of anesthesiology (1,2). Typically, the rooms are distant from the main operating room. The layout of the rooms is awkward for induction and maintenance of anesthesia due to the presence of one or 2 X-ray fluoroscopy arms. Often, the medical gas connections are not at the normal location of the room, cephalad to the patient's right shoulder. Neurointerventional procedures demand anesthesia maintenance with the anesthesia machine at the patient's left foot to keep the anesthesia machine and connections from being struck by the fluoroscopy arms rotating around the patient.

Design and Construction: We provided two anesthesia gas booms in each room, one for cardiac catheterization procedures, the second for neurointerventional procedures. These booms have identical medical gas, electrical and data connections that we have in our institution's operating rooms (3). The anesthesia monitors are integrated into the video distribution system. Each room has connections for cardiopulmonary bypass and nitrogen connections to facilitate ventriculostomy placement.

After opening the first location, we noticed shortcomings with the design. Shifting the anesthesia machine from cardiac to neurointerventional boom takes more than 20 minutes. This room had to be left in the neurointerventional configuration to facilitate in starting emergency cerebral thrombectomy procedures. In this room, the anesthesia connections are on the same boom as the main procedure monitor. When anesthesia is not present, the hoses and cables run across the floor, and the machine is always an obstruction in room. We also found that the non-invasive blood pressure hose limited how far the anesthesia machine could be located away from the procedure table.

In the second room, the anesthesia connections for neurovascular procedures were moved to a dedicated boom. This facilitated moving the anesthesia machine to the head of the room for induction, then moving toward the left foot of the bed for maintenance of anesthesia. The boom also had range to allow parking of the anesthesia machine on the wall at the top left corner of the room..

In the third room, we relocated the cables for the anesthesia monitors to a mount on the rail at the left foot of the table. This remote monitor was linked to two connectors in a box in the floor under the foot of the table. Each of these connectors is routed to each anesthesia boom (cardiac and neurovascular), for connection to the anesthesia monitor display on the anesthesia machine. An anesthesia machine parking space was added on the left side of the room between the supply cabinets. Finally, a remote control anesthesia monitor was added inside the control room to allow the anesthesiologist to monitor the patient from the control room to minimize x-ray exposure. .

Conclusions: By designing each room in sequence, we learned the shortcomings of the preceding design and applied these lessons to the next room. The remaining problem is easing transition from induction to maintenance in neurovascular procedures. It remains a complex dance maneuvering the anesthesia machine, its boom and the main procedure monitor boom. Involving a multidisciplinary team throughout design and construction of interventional suites improves the care of patients and the experience of users.

References:

1) Fearson, Mary, “Hybrid Operating Room Design Basics”, Facility Guidelines Institute (FGI). Guidelines for Design and Construction of Hospitals, 2018 ed. (FGI, 2018).
2) Rogoski, J, et. Al. “Hybrid Operating Rooms”, American Society of Anesthesiologists (ASA). Operating Room Design Manual 2010-11 ed. (ASA, 2011)
3) American Society of Anesthesiologists Committee on Standards and Practice Parameters. Statement on nonoperating room anesthetizing locations. October 17, 2018. Available at: https://www.asahq.org/standards-and-guidelines/statement-on-nonoperating-room-anesthetizing-locations.