

# Can cerebral angiography be performed outside the hospital?

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Cerebral angiography was pioneered by Portuguese neurologist and Nobel Prize awardee Egas Moniz at the University of Lisbon in 1927. It is remarkable to consider that it took almost 50 years for computed tomography (CT) scans to provide an alternative imaging option for cerebral vessels. Indeed, present day cerebral angiography has evolved<sup>1</sup> from those early days of 'encephalographie arterielle' (arterial encephalography) utilizing direct puncture and/or surgical exposure with sodium iodide as a radiopaque agent. Moniz would likely be astounded by how safe and precise an imaging technique it has become. The evolution includes but is not limited to continued advancements in imaging technology. Examples include digital subtraction angiography, higher resolution imaging, 3D rotational angiographic technique, access devices, catheter technology, and improved contrast agents. Today, cerebral angiography is arguably a more essential tool in diagnosing and treating cerebrovascular disease.

Before the 1970s, the technique involved a direct carotid puncture, which was later replaced by the current predominant method of accessing from the femoral artery mainly due to hemorrhagic complications at the access site. In the past 20 years, following extra neuro-interventional trends, a further shift from transfemoral to transradial access has taken place, driven largely by data demonstrating a reduction in access site complications.<sup>2</sup> However, other benefits such as decreased length of stay and reduced procedural costs have also been shown.<sup>3</sup> Early neurointerventional adopters of the transradial approach have noted improved patient satisfaction, and this trend has continued.<sup>4</sup>

As we approach the 100th anniversary of cerebral angiography, the one near-constant factor that has not changed is the service location. In fact, diagnostic cerebral angiography has been performed in hospital-based departments since its

inception. In 2008, the Centers for Medicare & Medicaid Services recognized that endovascular procedures could be done in an office setting at a significant savings compared with hospital-based procedures. Available data support the view that procedures done in an office are as effective as those done in a hospital and do not compromise patient safety.<sup>5</sup>

The perceived neurological risks and other requirements such as general anesthesia and 24-hour emergent coverage, have collectively rendered the notion of conducting cerebral arteriography in an outpatient facility, distant from any hospital-based resources, inconceivable in the minds of many neurointerventionalists. The question nonetheless remains, is there a subset of cerebral angiography patients who could be safely performed in an outpatient setting, such as an office-based laboratory, or ambulatory surgery center?

Office-based laboratories, or outpatient interventional suites, are smaller facilities often located within a physician's office or a clinic, and are primarily used for diagnostic testing, or minimally invasive procedures generally requiring no-, single agent or moderate sedation, that is, dialysis access maintenance, lower-extremity interventions, venous interventions, and other minor vascular procedures. The equipment and procedures performed in an office-based laboratory are generally less complex compared to those in a surgical setting, such as an ambulatory surgery center which is designed to accommodate surgeries that may require general anesthesia but do not use an overnight hospital stay. Ambulatory surgery centers are staffed with surgical teams and anesthesiologists, and therefore adhere to stricter federal and state-specific safety, regulatory, and accreditation standards.<sup>6</sup>

Whether utilizing an office based laboratory or an ambulatory surgery center, the trend toward performing minimally invasive procedures in an outpatient office-based setting is growing rapidly in the United States. Over 700 office based laboratories and 8000 ambulatory surgery centers currently exist in the United States, and this number is steadily expanding. To date, only a handful are equipped with biplane fluoroscopy machines, which

remains the preferred imaging equipment for neuroendovascular procedures.

Compared with hospital outpatient departments, pure outpatient facilities can provide greater convenience for patients, allow physicians enhanced autonomy, and potentially generate more revenue after expenses. In addition, COVID-19 has spurred a trend toward outpatient care to keep patients out of the hospital and potentially farther away from infections. Patients are increasingly looking for care near their homes, avoiding extended waits to consult with a specialist physician, and preferring a comfortable, patient-centered setting with amiable, familiar staff. With the increasing numbers of emergent neurointerventional procedures, having an outpatient facility to offset elective case volume could reduce cancellation rates, delays in start times, and improve efficiency. The above would almost certainly improve patient satisfaction.

Moreover, there are financial advantages to consider. The costs associated with outpatient procedures performed at office based laboratories and ambulatory surgery centers are notably lower compared with the costs incurred when the same procedures are conducted within an inpatient setting. This cost-effectiveness appeals not only to the Centers for Medicare & Medicaid Services but also to other payors aiming to reduce the overall burden of healthcare expenses.

Furthermore, physicians stand to gain economically as well. While the Affordable Care Act, under Section 6001, restricts the establishment and expansion of new physician owned hospitals, the landscape is more permissive when it comes to physician ownership of office based laboratories and ambulatory surgery centers. These outpatient facilities can be owned by physician group practices, individual practitioners, business ventures, or through collaborative arrangements involving any combination of these entities and a hospital. By conducting procedures in a physician-owned ambulatory surgery center, owners can access supplementary income through facility fees, in addition to the conventional professional fees earned as proceduralists. Hence, this shift toward outpatient procedures is being propelled by a desire for enhanced physician oversight and responsibility throughout the patient's healthcare journey, all while maintaining or even improving treatment outcomes and concurrently boosting provider income.

There are caveats as well. First, given the narrower 'profit' margins in those settings, it becomes imperative for

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providers to effectively manage expenses without compromising the quality of outcomes. Second, running an outpatient facility carries a notable financial risk, and achieving success necessitates a well-structured business strategy. In the context of neuro-diagnostic procedures, it also involves a substantial capital investment, including the acquisition of a biplane fluoroscopy machine, as well as expenses related to disposable inventory, personnel, and additional equipment. This challenge is compounded by the backdrop of rising expenses associated with both supplies and labor. Thirdly, physicians working in outpatient laboratories who are employed by hospitals, rather than being practice owners, may witness a decline in their earnings as the facility fees generated by their procedures decrease. Moreover, non-hospital-affiliated physicians might experience a decrease in their perceived value, as their contribution to the hospital diminishes, potentially impacting their service line management agreements with healthcare institutions.

Furthermore, the need to maintain growth makes exploring multi-specialty practices a logical choice, because neuro-surgical procedures are usually less frequent, than interventional vascular, radiology, and pain procedures. In fact, much of the existing literature relates to outpatient based vascular surgery, cardiology, and interventional radiology practices, which started to move certain procedures into the outpatient setting years ago. Their data overall supports the safety of outpatient-based procedures.<sup>5</sup>

To the best of my knowledge, safety data specifically pertaining to cerebral angiography in these settings is currently unavailable. Nevertheless, it is worth noting that this trend initiated by other interventional fields years ago has now extended its reach to the realm of neuroendovascular procedures. Thanks to developments such as radial access, diagnostic cerebral angiography, spinal angiograms and various other endovascular pain procedures have been effectively conducted within both office based laboratories and ambulatory surgery centers. This progression signifies a stride forward for our specialty, ushering it into a novel domain of practice.

In summary, as the endovascular trend to the outpatient setting continues to unfold across the United States, improvements in neurointerventional technology will play a significant role in furthering this trend. Radial access and quicker recovery times are good examples. Fully integrated fluoroscopy equipment will be offered in smaller packages requiring smaller footprints allowing multi-specialty collaboration for outpatient procedures. Finally, in the age of ballooning healthcare costs, cutting expenditures is at the forefront of the minds of many system leaders. Wouldn't it make sense to embrace a transformation of where and how neurointerventionalists are delivering these services to our patients?

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