Enhancing Education to Avoid Complications in Endovascular Treatment of Unruptured Intracranial Aneurysms: A Neurointerventionalist’s Perspective

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ABSTRACT

SUMMARY: It is of utmost importance to avoid errors and subsequent complications when performing neurointerventional procedures, particularly when treating low-risk conditions such as unruptured intracranial aneurysms. We used endovascular treatment of unruptured intracranial aneurysms as an example and took a survey-based approach in which we reached out to 233 neurointerventionalists. They were asked what they think are the most important points staff should teach their trainees to avoid errors and subsequent complications in endovascular treatment of unruptured intracranial aneurysms. One hundred twenty-one respondents (51.9%) provided answers in the form of free text responses, which were thematically clustered in an affinity diagram and summarized in this Practice Perspectives. The article is primarily intended for neurointerventional radiology fellows and junior staff and will hopefully provide them the opportunity to learn from the mistakes of their more experienced colleagues.

A smart man makes a mistake, learns from it, and never makes that mistake again. But a wise man finds a smart man and learns from him how to avoid the mistake altogether.

Roy H. Williams

As neurointerventional fellows, we are bound to make mistakes. Human errors in neurointervention occur in up to 12% of cases, and they are, to some degree, unavoidable, but mentorship can prevent some of them from happening. The weighing of treatment risks and benefits is of particular importance for low-risk conditions such as unruptured intracranial aneurysms, in which complications weigh heavily on the neurointerventionalist. Thoughtful mentors will share their experiences and, most important, their errors and failures with us so that we can learn from their mistakes. What do experienced neurointerventionalists wish they had been told as fellows? We used endovascular treatment of unruptured intracranial aneurysms as an example and took a survey-based approach in which we reached out to 233 neurointerventionalists to answer this question (mostly senior staff; for detailed demographics and countries of survey participants see Online Tables 1 and 2). Participants were asked the most important points staff should teach their trainees to avoid complications in endovascular treatment of unruptured intracranial aneurysms. One hundred twenty-one respondents (51.9%) provided answers in the form of free text responses, which were thematically clustered in an “Affinity Diagram” (Online Appendix). This format was deliberately chosen to avoid narrowing the responses down to certain topics by suggesting topics or providing examples. The free text answers were then screened, and it was determined whether they contained thematically distinct messages. If the latter was the case, the response was split accordingly. Responses were then manually clustered by identifying common themes. Thematically similar responses were clustered together. Those clusters with the largest number of responses were extracted and formed the basis for the article. They are shown in the Table and summarized below (for key recommendations, see also the Figure).

Asking for Help

Neurointerventional skills are learned progressively, and a realistic and honest appraisal of one’s own skillset and limitations was considered crucial by most respondents. Fellows should know when to refer a case to a more experienced colleague and never be hesitant to reach out to colleagues for help and advice; not doing so means putting the patient at risk.
Many responses emphasized the importance of honestly discussing and revisiting complications and their management in an open and nonjudgmental environment,2 be it in morbidity and mortality rounds,3 interaction with colleagues,4 or professional society meetings.

**Treatment Indication**
Ensuring successful treatment requires picking the right patients in the first place. Participants advised fellows to perform a thorough risk-benefit analysis before every treatment decision. Knowing which cases not to treat in the early years of practice was considered key knowledge for fellows.5 Proper review of noninvasive imaging to anticipate and prevent potential complications and planning of alternative strategies, “having a plan A, B, and C” as one of the respondents stated, was thought to be essential to handle unexpected events.

The goal is to ensure that patients receive the best possible treatment, be it endovascular, surgical, or conservative (“watch

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**Summary of the most common response clusters with exemplary responses**

| Response Clustera | Explanation | Exemplary Responsesa |
|------------------|-------------|-----------------------|
| General advice   | Realistic appraisal of one’s skillset and its limitations | “We need calm and honest fellows, not cowboys” |
| Humility and ethical standards | | “Be aware of overestimating your own skills” |
| Interaction with colleagues and asking for advice | Reaching out for advice and help from more experienced colleagues when needed | “Don’t be a hero—stop and ask!” |
| Critically revisiting complications and their management | Discussion of complications with colleagues in and outside M&M rounds and meetings, constructive feedback, root-cause analysis | “Show fellows their own complications and deaths, and how to deal with them if there was a second chance” |
| Preprocedural phase | Patient-centered treatment decision-making, knowing which patients one should not treat | “Learn when to say no” |
| Indication and patient selection | Thorough review of prior imaging, a priori planning of specific procedure steps, anticipation of potential problems and alternative solutions | “What not to treat in the first 3–5 years of practice” |
| Preoperative planning | Considering surgical options (clipping, sacrificing the parent vessel) and watch-and-wait strategies | “Knowing which patients can be safely followed” |
| Keeping alternative treatment options in mind | Solid knowledge about cerebrovascular anatomy | “Study the 3D angio, don’t rush, plan your approach. What’s the plan B, C?” |
| Theoretic knowledge | Acquiring technical skills in a simulation environment before performing real cases | “Work-up each case very carefully and try to predict complications” |
| Technical skills | Standardization of procedure steps, prespecified protocols for the management of complications | “Before doing a procedure, think of everything that can induce a procedural complication” |
| Intraprocedural phase | Recognizing the point at which continuing the procedure will likely cause more harm than benefit, avoiding the “perfection trap” | “Less emphasis on endovascular being the be-all and end-all” |
| Keeping alternative treatment options in mind | | “Never forget that competent and adequate surgical clipping is feasible and sometimes ideal!” |
| Theoretic knowledge | | “More training in some programs on how to look at imaging” |

Note:—M&M indicates morbidity and mortality.

*For a detailed overview of response clusters and individual responses, see the “Affinity Diagram” in the Online Appendix.*

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and wait”), and this will require an open and unbiased discussion among physicians from different medical specialties, including diagnostic and interventional neuroradiology, neurosurgery, and neurology.

Simulation Training and Standardized Procedural Steps

Simulation training constitutes a safe environment to practice technical skills.6-10 Physicians believed that fellows should train as much as possible in a simulation environment to learn basic catheter skills before performing real cases. Standard operating procedures for every procedure step, close adherence to protocols for the management of intraprocedural complications, and choosing the simplest treatment approach possible were additional points physicians considered of high importance.11

Safety

Using a few devices well was thought to be much wiser than the use of a wide variety of new devices, for which safety and efficacy data are often limited: “keeping it as simple and safe as possible,” as many of them put it. Accepting imperfection and avoiding unnecessary and dangerous perfectionist steps toward the end of a procedure were perceived crucial for fellows: “If you think that you can put one more coil, this is [the] time to stop.”

Humans make mistakes, and they make them frequently. Neurointervention is no exception to this rule, and the stakes are high. The advice summarized in this article (see the Figure for key recommendations for fellows and senior staff) is intended to help fellows and junior staff “to be wise” as Roy H. Williams put it—that is, to learn from the mistakes of their more experienced colleagues.

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