ONLINE APPENDIX: AFFINITY DIAGRAM

"If you were to advise senior staff, what should they teach their fellows to effectively reduce procedural complications in the treatment of unruptured intracranial aneurysms?"

Note: Responses that matched >1 cluster have been duplicated and added to the respective clusters.

Cluster: Standard Operating Procedures

Work hard and in a precise and standardized manner

Show all types of possible complications and write "protocols" to deal with them.

Keep standard procedures and management.

Stick to the given protocols each and every time.

Utilize standardized treatment and periprocedural medication guidelines within the institution.

To establish procedural standards.

Meticulous planning of the procedure.

Standardized protocols to be followed and drilled in standards.

To strictly follow recommendations.

Protocolization of complication management, with a check list.

Cluster: Keep It Simple

Keep it as simple and safe as possible.

Teach the simplest as the best.

Learn the basics first and learn them well.

Knowing the material to be used beforehand.

Start from the basics: keep it simple, clean, and fast.

Stick with few devices and do large numbers of patients with them.

Training, training, training, and be familiar with simple "base" techniques before practicing "extraordinary" cases that someone else has done.

Simplify your procedures until your skills improve.

Always go for the simplest method.

Keep it simple, learn to coil really well, instead of mastering a new device every year.

Cluster: Focus on Safety

Personal follow-up of the patient pre- and postprocedure for all details, standards of safety: technical details of access, device choice, medication.

Keep it as simple and safe as possible.

Learn about "crew resource management" safety culture in aviation and consider how it can be applied in your lab.

Being prudent is better than being daring; the objective of the treatment is not to look pretty but to avoid the rupture of the aneurysm.

Gain the trust of seniors, ask for advice, and work with high safety margins.

Cluster: Interaction with Colleagues/Asking for Help

Do not hesitate to ask for advice in case of whatever is the problem, "We're smarter together than we are alone."

Always ask a senior in case of complications.

The importance of discussion with senior staff, not only before treatment but also successful results.

Know your limitations and when to stop and ask for help or when to refer a patient to a more experienced center.

Gain the trust of seniors, ask for advice, and work with high safety margins.

There is a wide variability of complication rates based on operator skills and experience. Be comfortable referring for a second opinion.

Don't be a hero—stop and ask!

To be humble and know their limits; it is not a shame to reschedule a patient with more experienced staff.

Never forget that behind a technical case you have a patient's life: You are not a hero, think twice before taking a decision, don't be a fashion victim, use what you are confident with, and never be ashamed of stopping a procedure or asking a senior for advice.

Always ask for help if any question arises in a case.

To discuss before the procedures and to perform them together.

Never work in isolation.

Ask for help.

Analyze every case together with an experienced colleague. Let the experienced colleague join the procedures as often as possible.

Staff review of every case, success or failure. If a senior has a 1% risk of complications after 10 years of practice, a beginner will probably have more.

Cluster: How to Interact with the Fellow

Sincere teaching! Better mentorship, more discussions!

Make fellows discuss a plan of care and then discuss why it is right or wrong.

To come to the angiosuite more often.

The senior staff should teach how to avoid procedural complications in a case-by-case manner.

Go through every case in detail, especially tell them how you plan and why you choose a specific approach.

Let them experience under their responsibility and your supervision.

Fellows learn more from watching what we do than from what we say.

Maintain constant assessment and communication; tell them what they need to hear, rather than what they want to hear.

Need to constantly discuss during the case what if this happens so that they are ready when it actually does.

Cluster: Keep Neurosurgical Alternatives in Mind

Never forget that competent and adequate surgical clipping is feasible and sometimes ideal.

Be there, help with advice, discuss every case before and after treatment with your entire team, discuss alternative techniques and also neurosurgery.

Less emphasis on endovascular being the be-all and end-all, more papers on surgery treatments as well as endovascular.

Cluster: Humility and Ethical Standards

Teach being less selfish.

Learn to assess one's own limits.

Teach humility.

Culture change, what would you do for your own family member in this case?
Humility, honesty, good clinical practice.
Encourage thoughtful consideration before, during, after cases, and discourage "cowboy" behavior.
Be aware of overestimating your own skills.
Be humble, know the limits of your competence.
Personal responsibility must be enhanced.
Know your limitations and when to stop and ask for help, or when to refer a patient to a more experienced center.
To be honest and do what you feel to be able to treat; if something seems to be too difficult, put your pride aside. The patient's health comes first.
We need to know how far we can go with our own hands, which must be different from what they can do in the literature.
Don't be a hero—stop and ask.
Prudence and modesty. This is a job that is learned progressively.
Not wanting to prove a result at all cost. Calm and honest fellows, not cowboys.
Concentration in every cerebral angiography case.
To be humble and know their limits; it's not a shame to reschedule a patient with more experienced staff.
That nobody is perfect, everybody forgets failures but remembers complications.
To understand personal skill levels. Honestly self-review all cases in which a complication has occurred and understand what went wrong. Never blame it on device quality or malfunction.
Teach modesty, patience, patient-centered care, and how to reduce unnecessary and perfectionist steps when performing a case or dealing with patients and family.
Report honestly about every case and every complication.
Never forget that behind a technical case you have a patient's life; you are not a hero, think twice before making a decision, don't be a fashion victim, use what you are confident with, and never be ashamed of stopping a procedure, or asking a senior for advice.
Be honest. Try not to do what you are not prepared to do
Honest reflection (team discussion, proper morbidity, and mortality).
Humility.

Cluster: Avoiding the Perfection Trap/When to Stop

If you think that you can put one more coil, that is [the] time to stop it.
There is no shame if you have to bail out.
A good result is good enough.
Better understanding of "stopping points."
Enemy of good is perfect. Know when to stop.
Less is sometimes more. Perfect is the enemy of good.
Being prudent is better than being daring; the objective of the treatment is not to look pretty but to avoid the rupture of the aneurysm.
Accept imperfections.
To avoid ideal-perfect control DSA images.
Teach modesty, patience, patient-centered care, and how to reduce unnecessary and perfectionist steps when performing a case or dealing with patients and family.
Never forget that behind a technical case you have a patient's life; you are not a hero, think twice before making a decision, don't be a fashion victim, use what you are confident with, and never be ashamed of stopping a procedure or asking a senior for advice.
Imperfect embolization produces less rupture than untreated aneurysms.
We need to finish the procedures without making complications and we do not always need to do a perfect job, especially for unruptured aneurysms.
Know when you have to stop.
Don't let best be the enemy of good.
Know your limitations and when to stop and ask for help or when to refer to a more experienced center.
If you don't obtain a perfect result, do not exaggerate but follow the patient and re-intervene later.

Cluster: Indication and Patient Selection

Deciding on who should be treated in the first place. Proper risk, benefit, and alternative treatment analysis for each patient based on numerous variables (age, anatomy, genetics, and so forth).
Teach them how to correctly select which aneurysms should be treated.
Aneurysm selection; make sure the indication for treatment is robust: consent well.
Learn when to stop and say no.
Errors in judgment (choosing to treat/extra coil/aiming for perfect) are more likely to cause a problem than a technical issue with skills or devices.
Good indication; treatment strategy; plan A, B, C; and execution.
More focused on patient selection and management of complications.
Treat the patient, not the disease.
Support a holistic approach to neurointerventional training.
Encourage thoughtful consideration before, during, after cases, and discourage "cowboy" behavior.
Indications and better understanding of "stopping points."
Emphasis on patient selection—not overtreatment.
Be transparent on the discussion of possible complications and natural history.
Avoid low-risk difficult aneurysms.
Discuss the rationale of the treatment and encourage training.
Teach them to think correctly...the choice of when to do and when not to do is the most important teaching.
Correct indications.
What not to treat in the first 5 years of practice.
Which patients can be safely followed?
Focus on appropriate indications for treatment, then proper treatment selection and risk/benefit assessment.

Cluster: Theoretic Knowledge

Be properly trained, both technical and theoretical (!), before you start.
Neurologists out there need to get better training on imaging and seeing the problems as they occur. Perhaps need more training in some programs on how to look at imaging.
Teaching the anatomy.

I recommend reading a textbook.

Cluster: Practical Training and Techniques

Stepwise experience of treatment for individual fellows.

See several hundreds of cases, attend at least 100 cases as an assistant, and do dozens of cases together.

Be properly trained, both technical and theoretical (!), before you start.

Good training starts with good practice and hands-on training.

To give more hands-on experience.

Teach meticulous technique and let the fellow do most of the case with your close supervision (resist the urge to take over).

I want them to talk principles for technical executions and to confirm their fellows' skills.

Start with the basics; do lots of angiograms.

Use of heparin and infusions, use of rescue devices, eg, balloon or stent.

Cluster: Simulation Training

Give them enough time on simulations first.

Always be careful with patients and train a lot in the silicone models/computer simulators.

Simulator training if available.

Silicone model training for cases and complications.

Simulators are how you need to learn and master the nuances of different cases, not trial and error on patients.

Cluster: Joining and Maintaining a Data Base

To have a registry of complication, management, and outcome

Join a society registry.

Record all the patients in a data base.

Cluster: Other

Be as comfortable as possible during the procedure. Is the table at the right height, are the angio screens appropriately positioned, is the magnification sufficient, is your endovascular access stable? Prep a balloon even if you don't think you need it; you won't regret it if a disaster happens. Study the 3D angio, don't rush, plan your approach. What's the plan B, C?

Teach the concept of the hype cycle curve for new devices.

Encourage them to continue learning after they leave their training and track their outcomes.

No ability to treat alone before enough experience is gained.

On-line Table 1: Respondents' baseline characteristics ($n = 121$)[a]

Variable	
Age (median) (IQR) (yr)	47 (41–56)
Female sex (No.) (%)	12 (9.9)
Career stage (No.) (%)	
Resident	2 (1.6)
Fellow	2 (2.5)
Junior staff (within 5 years from board certification)	12 (9.9)
Senior staff (>5 years from board certification)	104 (86.0)
Specialty (No.) (%)	
Interventional neuroradiology	81 (66.9)
Neurosurgery	30 (24.8)
Neurology	8 (6.6)
Other	2 (1.7)
Years of neurointerventional experience (median) (IQR)	15 (8–23)
Personal annual endovascular UIA treatment volume (No.) (%)	
<10	13 (10.7)
10–20	25 (20.7)
20–30	32 (26.5)
30–40	13 (10.7)
40–50	7 (5.80)
>50	31 (25.6)
Institutional annual UIA treatment volume (No.) (%)	
<20	14 (11.6)
20–40	22 (18.2)
40–60	24 (19.8)
60–80	17 (14.1)
80–100	14 (11.6)
>100	30 (24.8)
Frequency of UIA case discussion in a multidisciplinary board (No.) (%)	218 (93.56)
Not at all	8 (6.6)
Only selected UIA cases	43 (35.5)
All UIA cases	70 (57.9)

Note:—IQR indicates interquartile range; UIA, unruptured intracranial aneurysm.

* Survey data were summarized using descriptive statistics. All participants gave their consent before answering the survey, and participation was voluntary.

On-line Table 2: Participants' countries in alphabetical order (*n* = 121)[a]

Country	No. of Participants (%)
Austria	1 (0.8)
Belgium	1 (0.8)
Brazil	1 (0.8)
Canada	10 (8.3)
Chile	1 (0.8)
Croatia	1 (0.8)
Czech Republic	1 (0.8)
Denmark	2 (1.7)
Estonia	1 (0.8)
France	12 (9.9)
Germany	11 (9.1)
Hong Kong	1 (0.8)
India	9 (7.4)
Italy	9 (7.4)
Japan	17 (14.1)
Kazakhstan	1 (0.8)
Mexico	1 (0.8)
the Netherlands	2 (1.7)
Portugal	2 (1.7)
Serbia	1 (0.8)
South Africa	1 (0.8)
Spain	4 (3.3)
Switzerland	1 (0.8)
Turkey	2 (1.7)
United Kingdom	3 (2.5)
United States	25 (20.7)
Total	121 (100)

[a] All participants gave their consent before answering the survey, and participation was voluntary.