Training Protocols for Neuroendovascular Surgery

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Abstract

There is an increasing adoption of neuroendovascular surgery in clinical practice worldwide, which represents an important paradigm shift in the management of patients with diseases of the vasculature of the central nervous system. As newer generations of neuroendovascular "specialists" are trained, they must practice their specialty at a certain basic standard that ensures competent care and the ability to prevent and also deal with complications as and when they may arise. Therefore, there is an increasing need for the adoption of standardized training protocols in the field. Training for neuroendovascular procedures is necessary for the safe conduct of procedures and to advance the field. In this chapter, we shall discuss the current needs and protocols, taking certain prototypical training guidelines into account.

Keywords

Neuroendovascular · Surgery · Training Neurointervention · Interventional neuroradiology

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17.1 Introduction

Neuroendovascular surgery (or NES) (also called interventional neuroradiology/endovascular neurointervention/neurovascular intervention) is the medical subspecialty that uses minimally invasive catheter-based technology and radiological imaging combined with clinical and technical expertise to diagnose and treat diseases of the vasculature of the central nervous system, including the head, neck, and spine. In specific clinical scenarios, endovascular procedures have augmented the efficacy of, and also replaced, open surgical operations. There is increasing adoption of neuroendovascular surgery in clinical practice worldwide, which represents an important paradigm shift in the management of patients with diseases of the vasculature of the central nervous system. As newer generations of neuroendovascular "specialists" are trained, they must practice their specialty at a certain basic standard that ensures competent care and the ability to prevent and also deal with complications as and when they may arise. Therefore, there is an increasing need for the adoption of standardized training protocols in the field.

Vascular pathology and its repercussions on the central nervous system may frequently be devastating. Hence the physician involved in treating these problems needs to focus on prevention, salvage, and augmentation of nervous

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system function. Training for any skills based specialty consists of many interlapping processes.

The most basic requirements are cognitive skills. In the beginning, the trainee must be familiar and conversant with the unique anatomy, physiology, and pathological aspects. In this specialty, this would entail knowledge of the nervous system, its function, its vascular connections and the pathologies associated with the vasculature which affect the nervous system. An important point, in our opinion, is to focus on the neurological outcome for prevention, mitigation, salvage, or augmentation of function and not just successful radiological outcomes.

Physicians coming to train in this specialty typically come from either radiology or a neurosurgical and, more recently, from a neurology background. In different parts of the world, the proportions vary. Hence training must factor for this diversity. A trained neuroendovascular specialist has to be able to work in a team with the related specialties of traditional neurosurgery, neurology, and neurocritical care specialists.

The basic technical skills needed are similar to endovascular techniques used in other systems in the body. Neuroendovascular skills may differ because of the differences and unique characteristics in the vasculature of the central nervous system. Familiarity with and ease of use of various devices, catheters, and embolics, need to be introduced and mastered. In this chapter, we shall discuss the current needs and protocols, taking certain prototypical training guidelines into account. Many nations have their guidelines, which has overlap. Some systems are discussed below.

17.2 Training Protocols

17.2.1 Europe

The European guidelines for training in the field of neuroendovascular surgery (interventional neuroradiology) have been have been developed by a working group of the European Society of Neuroradiology (ESNR) and the European Society of Minimally Invasive Neurological Therapy (ESMINT) on the initiative and under the umbrella of the Division of Neuroradiology/Section of Radiology of the European Union of Medical Specialists (UEMS) [1].

17.2.1.1 The Program

The primary goal of the training program, as laid down in the guidelines, is to provide the trainee with a broad knowledge base, the procedural skills and experience, professional judgment, and self-criticism required to practice interventional neuroradiology safely [1].

National professional licensing bodies, or in their absence, a European association/society/organization (UEMS or European subspecialty societies—for example, ESNR, ESMINT or boards cooperating with UEMS) provide a general program for accrediting teaching institutions. This is a voluntary procedure aimed at securing high quality and good standards of practice in the teaching program [1].

The teaching program must be within a clinical neuroscience institution, or a network of such institutions, with all the appropriate related specialties represented. The patient population at the institution must have a diversity of illnesses (brain, head and neck, spine) from which broad experience in interventional neuroradiology can be obtained by the trainees [1].

Training could be limited to a specific area of interventional neuroradiology—for example, spinal interventions or endovascular treatment of ischemic stroke, including the management of complications, provided that the minimum annual activity for the specific area (as outlined in the section on requirements/criteria for institutions), is fulfilled and site conditions and operational guidelines are guaranteed by the training institution, according to the ESNR/ESMINT/UEMS guidelines for standards of practice in interventional neuroradiology [1].

For training that is limited to specific areas of interventional neuroradiology, such as endovascular treatment of ischemic stroke, the requirements of existing multi-society global recommendations should be applied [1]. Recommendations include “Training guidelines

for endovascular ischemic stroke intervention: an international multi-society consensus document [2] and the Standards of practice in acute ischemic stroke intervention: international recommendations [3]."

17.2.1.2 Requirements/Criteria for Trainees

Trainees must have a valid license to practice medicine within their respective countries, which must be recognized at the country/countries where training in interventional neuroradiology is to take place [1].

Before entering interventional neuroradiology training, trainees are required to be qualified physicians in a training program of a medical specialty or have accomplished training in a recognized medical specialty [1].

The education and training needed to become a specialist physician with a particular qualification in INR consists of [1]

- 12 Months *mandatory* dedicated training in diagnostic neuroradiology.
- 24 Months *mandatory* dedicated training in interventional neuroradiology
- 12 Months *recommended* clinical training in neuroscience.

Depending on previous training, these durations may be reduced as credit is given for previous training and clinical skills. Assessment of previous training and clinical skills, and evaluation of the remaining training time has been laid out to be the responsibility of the director and each of the co-directors of the program after thorough and careful assessment of previous training and experience [1].

Trainees should keep a trainee portfolio containing details of previous training posts, examinations passed, lists of publications and presentations at meetings, courses attended, cumulative procedural totals, and copies of assessment forms from the different training periods [1].

Trainees are to familiarize themselves with knowledge pertaining to neuroanatomy (with focus on vascular anatomy) and neuroembryology (with focus on vascular embryology), spine biomechanics, neurobiology including molecular genetics, neurophysiology, and biology of pain, pathology with a focus on vascular diseases, including inflammatory and autoimmune diseases and the natural history of neurovascular diseases [1].

Trainees are to be capable of taking a clinical history and performing a neurological examination and to communicate with patients and relatives, fellow residents, other clinicians and hospital staff and administration [1].

Trainees must be competent in the selection of various treatment options (indications/contraindications) based on knowledge and communication in a multidisciplinary environment and must be capable of carrying out appropriate pre-procedural and peri-procedural management such as patient preparation before the procedure, intraprocedural maintenance of homeostasis and organization of follow-up procedures. They must also possess adequate knowledge of the relevant clinical pharmacology, including drug–drug interactions, pre- and post-procedural drug management, and also neurointensive care [1].

Trainees must also possess adequate knowledge of radiation physics, radiation biology, and radiation protection [1].

Trainees must possess adequate knowledge of the technical aspects, the proper selection, and the interpretation of various neuroradiological studies, including digital subtraction angiography, CT, MRI, and ultrasound, including the management aspects of various contrast materials such as their interactions and complications [1].

Trainees are expected to know about appropriate pre- and post-procedural patient management, relevant clinical neuropharmacology, as also with the technical aspects of the procedure (such as percutaneous access to the vascular system, the head and neck compartments, and the spine, the use of delivery systems like needles, catheters, wires, and rinsing systems, skillful management of radiological equipment, post-procedural management of the puncture site, procedure risks and limitations and complication management) [1].

Technical interventional neuroradiology expertise to be attained [1].

Percutaneous Treatments

Each trainee should perform *50 spine procedures as the first operator*, including a case mix of disk treatments, epidural spine treatments, nerve blocks, facet joint treatments, and vertebral bone augmentation treatments.

Neuroendovascular Procedures

- Each trainee should perform *100 digital subtraction angiography scans as the first operator before starting interventional endovascular* procedures.
- Each trainee should participate in *a minimum of 150 interventional endovascular procedures, of which in at least in half of the procedures, the trainee is the principal operator*. The *diversity* of these procedures should include endovascular treatment of aneurysms, acute ischemic stroke, extracranial, and intracranial angioplasty/stenting, embolization of brain arteriovenous malformation and dural arteriovenous fistula, and external carotid embolization.
- Each trainee should participate in a *minimum of 50 cases of revascularization and 50 cases of embolization* (*in either group in at least half of the procedures as the principal operator*).
- If the trainee does not complete the required number of procedures during the training period, the training should be prolonged accordingly.

The guidelines also state that trainees should have a firm knowledge of experimental design, performance and interpretation of results and basic knowledge of medical statistics. They are advised to participate in research projects conducted by the faculty or other trainees or to undertake projects as principal investigators and are encouraged to submit their work for presentation at national and international meetings. They should also understand the ethical aspects of research and what constitutes a conflict of interest [1].

Trainees are to keep a personal logbook for documentation of their skills and experience acquired during training. The logbook should be based on the picture archiving and communication (PACS) system and the radiology information system (RIS) of the clinic [1] and should state whether the trainee acted under supervision or was self-responsible. Trainees will have to demonstrate that they have participated in a wide spectrum of procedures which should include a balance of supervisor-assisted procedures and procedures performed personally under supervision. The logbook is to be produced by them at their examinations [1].

Trainees are to undergo evaluation of their progress (which includes assessment of the trainee's knowledge, technical skills, attitudes, and interpersonal relationships, decision-making skills and clinical management skills) at least twice a year during their program. This is to be conducted by the program director in consultation with the co-directors and the faculty [4].

17.2.1.3 Requirements/Criteria for Institutions

The optimal training program in interventional neuroradiology must take place and be organized in a single institution or in a network of institutions/departments in which the interventional neuroradiology unit is the core and is surrounded by clinical and diagnostic neuroscience units, and operating in accordance with the "Standards of practice in interventional neuroradiology: Consensus document from the ESNR/ESMINT/UEMS."

To qualify as a training program, the following conditions must be fulfilled [1]:

- The director and co-directors must have senior appointments in a recognized training institution that may be affiliated with academic institutions. Commercial interests cannot be involved in the organization and scientific content of the training.
- Ideally, the network should be involved in active interventional neuroradiology research.
- There should be ready access to general medical/neuro interventional texts and scientific

journals. Computerized literature search facilities should be available.

- The Interventional neuroradiology core must fulfill the following conditions
  - Interventional neuroradiology *caseload of a minimum of 100 cases/year of endovascular interventions and 50 cases/year of percutaneous spinal interventions*. INR case mix should include a *diversity* of vascular diseases, such as acute ischemic stroke, aneurysms, arteriovenous malformations, dural arteriovenous fistula, and spinal vascular malformations, in the respective percentages according to their prevalence. If accreditation is limited to percutaneous spinal interventions, the minimum caseload is 50 cases/year. If accreditation is limited to endovascular treatment of ischemic stroke, the minimum caseload is 50 cases/year.
  - The faculty of the training program must include *at least two members* practicing interventional neuroradiology.
  - The proportion of INR trainers to trainees must not exceed a *1:1* ratio.

17.2.1.4 Requirements/Criteria for Faculty and the Director of the Program

As laid down in the guidelines, the director of the training program must be an active interventional neuroradiologist certified according to the national regulations or in their absence by the UEMS cooperating European board.

The program director may have a senior academic appointment or a senior leading position as an interventional neuroradiologist in a nonprofit training institution.

The program director coordinates the network that constitutes the training program.

A network co-director should be well experienced and well respected as an interventional neuroradiologist or as a medical specialist in another appropriate specialty such as radiology, neuroradiology, neurosurgery, or neurology.

A director or co-director should participate in appropriate continuing medical education/continuing professional development activities according to the national regulations.

It is the responsibility of the program director and co-directors for enforcing the training charter and for selecting and supervising the trainee and faculty members.

The program director is expected to ensure that the program meets the required academic standard.

The program director should seek or need (if available) the national accreditation of the program by a national authority or the respective national neuroradiological professional.

17.2.2 USA

The guidelines for training in neuroendovascular surgery in the USA have been laid down by the Joint Section of Cerebrovascular Surgery for the American Association of Neurological Surgeons and Congress of Neurological Surgeons (JSCVS), the Society of NeuroInterventional Surgery (SNIS), and the Society of Vascular and Interventional Neurology (SVIN), jointly; to standardize and optimize the training program accreditation and individual certification processes for neuroendovascular surgery under the aegis of the CAST (Committee for Advanced Subspecialty Training) program of the Society of Neurological Surgeons (SNS) [5].

17.2.2.1 The Program

Participating societies connected to neuroendovascular surgery, including neurosurgery, neuroradiology, and neurology, have also agreed within an Accreditation Council for Graduate Medical Education (ACGME)–sponsored training curriculum and summary document [6]. Before starting a neuroendovascular surgery fellowship, this document requires that a trainee must complete an ACGME-accredited residency in neurosurgery, neurology, or radiology. The document also clarifies the need for preliminary training in stroke, critical care, and neuroradiology required for neurologists and radiologists [5].

The neuroendovascular surgery (NES) training program must foster a rich educational environment that includes frequent interactions between open vascular neurosurgery, critical

care, stroke neurology, neuroradiology, and state-of-the-art neuroimaging. Trainees must have the opportunity to participate in research and other scholarly activities. Each program must ensure that the learning objectives of the program are not compromised by excessive reliance on trainees to fulfill service obligations [5].

The Neuroendovascular Surgery Advisory Committee (NESAC) will operate through the CAST infrastructure to advise and assist CAST in the development and implementation of guidelines for accreditation of training programs and certification of individuals. NESAC comprises three persons from each of the neuroscience specialties of neurosurgery, neurology, and neuroradiology, working in concert with the CAST Chairman and Secretary.

17.2.2.2 Requirements/Criteria for Trainees

As per the guidelines, neuroendovascular training shall consist of three different phases [5].

1. *Preliminary Specialty Training*
   Each trainee should first fulfill requirements for their respective specialties.

   For neurosurgeons, they must first satisfactorily complete an ACGME-approved residency in neurological surgery and must be eligible for certification by the American Board of Neurological Surgery (ABNS) and must be in good standing in the ABNS.

   For neurologists, they must first satisfactorily complete an ACGME-approved residency in neurology and must be eligible for certification by the American Board of Psychiatry and Neurology and must be in good standing in the American Board of Psychiatry and Neurology. They must also complete an ACGME-accredited Vascular/Stroke Neurology Fellowship including, or in addition to, at least 3 months in the neurointensive care unit, or completion of and certification by a United Council for Neurological Specialties or CAST-approved.

   Neurocritical Care Fellowship.

   For radiologists, they must first satisfactorily complete an ACGME-approved residency in diagnostic or interventional radiology and must be eligible for certification by the American Board of Radiology and must be in good standing in the American Board of Radiology. They must also satisfactorily complete an ACGME-accredited neuroradiology fellowship including, or in addition to, at least 6 months of clinical service in neurological surgery, vascular neurology, or neurocritical care program before entering the advanced year of neuroendovascular surgery fellowship.

   As a result of the foregoing training, the fellowship candidate should have the expected level of competence required to enter neuroendovascular surgery. The candidate should be knowledgeable about the pathophysiology of cerebrovascular disease and skilled in the interpretation of neuroradiological studies. They are also to be well versed in the essentials of the intensive care unit management of neuroendovascular surgery patients, the complexities of anticoagulation and its reversal algorithms, and the manipulations of central and cerebral hemodynamics in patients with cerebral ischemia. They are also to be well versed with the specific management issues in neuroendovascular surgery patients requiring mechanical ventilation, with elevated intracranial pressure requiring clinical or invasive monitoring and with other conditions routinely encountered in an intensive care unit [5].
2. *Pre-Requisite Training*
   Candidates pursuing neuroendovascular surgery training must be technically competent in catheter access and manipulations within the vasculature supplying the brain and spinal cord. They are also expected to have a working knowledge of radiation biology in order to ensure patient and operator safety.

   The specific details of pre-requisite training include

- Performance of *at least 200 catheter-based diagnostic and interventional cerebral angiographic* procedures as a primary operator.
- Demonstrated competency in catheter techniques as validated by the NES Fellowship Program Director.
- ABNS Milestones one to four for cerebrovascular diseases and NES, completed and signed off by both the residency and NES fellowship program directors.

All candidates must demonstrate competency in catheter techniques and must perform *200 catheter-based diagnostic and interventional cerebral angiographic procedures as a primary operator before starting their focused NES training year*, regardless of their primary specialty. In a multi-year neuroendovascular surgery fellowship program, this pre-requisite may be obtained during the first year for any of the specialties [5].

3. *Advanced Neuroendovascular Surgery Training*

The specific details for all primary specialties (neurology, neurosurgery, and neuroradiology) include

- *Twelve continuous months* of a dedicated neuroendovascular surgery fellowship experience, during which the fellow performs a broad spectrum of endovascular procedures as defined by the core-competency requirements, to be performed after completion of their preliminary specialty and subspecialty requirements. For neurosurgeons, the 12-month neuroendovascular surgery fellowship may occur during residency but not before Post Graduate Year 6.
- *A minimum of 250 interventional treatment procedures should be performed as primary operators* to ensure that the trainee is exposed to *diverse* cerebrovascular diseases and the endovascular procedures used in their treatment. As a general guideline, those performed should have a core experience consisting of:
  - Forty aneurysm treatments, including ten presenting with rupture
  - Twenty intracranial embolizations (arteriovenous malformation, arteriovenous fistula, tumor)
  - Twenty-five intracranial or extracranial stent placements (at least five in each category and may include stents or flow diverters for aneurysms)
  - Thirty acute ischemic stroke treatments
  - Ten intracranial infusions (e.g., vasospasm, chemotherapy, and stroke)
  - Ten extracranial embolizations
  - Five spinal angiograms and embolizations

The guidelines state that those candidates who are unable to complete the required interventions during the 12 months should extend their training or seek training at other institutions. The continuity of care must be of sufficient duration, so the trainee is familiar with the natural history of each disease and the outcome of these treatment procedures [5].

17.2.2.3 Requirements/Criteria for Institutions

The institution where the training program is based should have an emergency room, a dedicated neurointensive care unit, ACGME-accredited residency programs in neurology and radiology, and ACGME, United Council for Neurological Specialties, and CAST-accredited fellowship programs in stroke and vascular neurology, neurocritical care, and neuroradiology.

There should also be a robust open surgical neurovascular program, meeting ACGME accreditation requirements at the same institution, a designated Comprehensive Stroke Center, and access to both adult and pediatric patients.

The imaging equipment and procedure rooms must be appropriately equipped and available for all neuroendovascular procedures. Imaging equipment should include biplanar fluoroscopy with digital subtraction and roadmap capability and rotational 3D imaging. The training program

must be hospital based to provide adequate inpatient, outpatient, emergency, and dedicated neurointensive care. Ancillary up-to-date imaging, such as MRI and CT with perfusion analysis, and ultrasound, are also necessary.

The environment at the institution should be education friendly and include frequent interactions between open vascular neurosurgery, critical care, stroke neurology, neuroradiology, and state-of-the-art neuroimaging. Trainees should be given the opportunity to participate in research and other scholarly activities. Each program must ensure that the learning objectives of the program are not compromised by excessive reliance on trainees to fulfill service obligations. Didactic and clinical education must have priority in the allotment of fellows' time and energy [5].

17.2.2.4 Requirements/Criteria for Faculty and the Director of the Program

A neuroendovascular surgery fellowship must have a fellowship *program director or co-director* who:

- Is certified by CAST and the American Board of Neurological Surgery (ABNS), American Board of Radiology, or the American Board of Psychiatry and Neurology.
- Has fulfilled all other respective specialty and subspecialty requirements, including Maintenance of Certification (MOC).
- Has special expertise in neuroendovascular surgery, with his/her practice concentrated in this field.
- Is appointed or co-appointed by and responsive to the Chair of the sponsoring ACGME-accredited program in neurological surgery, in consensus with the chairs of the ACGME programs in neurology and radiology if these specialties are represented as faculty in the CAST neuroendovascular surgery fellowship program. [5]

Trainee and faculty evaluations must be performed regularly and reviewed by the sponsoring CAST fellowship program director and any other appropriate institutional review committee to ensure the educational efficacy of the neuroendovascular surgery program.

The program must include *at least two faculty members* with special expertise in neuroendovascular surgery who are board-certified or tracking for certification by the ABNS or certified by the American Board of Radiology or American Board of Psychiatry and Neurology and possess all other additional required educational qualifications as determined by CAST and its NESAC. To ensure adequate teaching, supervision, trainee evaluation, and their academic progress, the trainee-to-faculty ratio must be *at least two* full-time neuroendovascular surgery faculty for the first graduating trainee completing the training program each year. More faculty members will need to be recruited to gain additional numbers of CAST-approved fellowship spots.

17.2.3 India

In India, the standards of training in neuroendovascular surgery have only recently (2019) been set by the National Board of Examinations, New Delhi, as a two-year post-doctoral fellowship program in Neurovascular intervention.

17.2.3.1 The Program

The objectives of the training program for the candidates are that they should [7]

- Understand symptomatology and signs of diseases that are amenable to neurovascular intervention.
- Perform basic neurological examination to evaluate patients with these disorders.
- Understand the pathophysiology and natural history of these disorders

- Understand the basics of imaging modalities, radiation physics and radiation biology and integrate information available from imaging studies and apply it to their practice.
- Communicate effectively with their patients and their relatives, and other doctors and colleagues.
- Know the indications and contraindications of the procedures in neuro intervention.
- Be well versed with the clinical and technical aspects of the procedures.
- Accurately report diagnostic and follow-up Cerebra Digital Subtraction Angiograms as well as Neuro Interventional procedures.
- Discuss medical and surgical alternatives to the neuro intervention procedures.
- Be competent in the pre- and peri-procedural management of patients undergoing neurointerventional procedures.
- Know how to prevent, recognize, and manage complications associated with these Neuro Interventional procedures.
- Handle neurointensive care management in consultation with Neuro-intensivists.

The program is a post-doctoral fellowship program (FNB) of 2 years duration.

17.2.3.2 Requirements/Criteria for Trainees

Candidates eligible to enter into the training program in the country are neurologists, neurosurgeons, and neuroradiologists. Accordingly, they must be in possession of recognized DM/DNB Neurology, MCh/DNB Neurosurgery and DM Neuroradiology qualifications, respectively. They must appear for an entrance examination and must qualify as per the rules and norms of the National Board of Examinations (NBE), New Delhi.

Candidates are put through the following rotations during their 2-year training period (depending upon their primary specialty).

Area of posting	Background qualification of trainee		
	Neuroradiology	Neurosurgery	Neurology
Neuro imaging	NA	1 month	2 weeks
Neurosurgery OT	2 weeks	NA	2 weeks
Neurology	2 weeks	2 weeks	NA
Neuro ICU	2 weeks	NA	NA
Other recognized Center for training in neurovascular intervention	1 month	1 month	1 month

At the end of their training period, candidates must appear for and pass the exit examination to be awarded the FNB Neurovascular intervention [7].

17.2.3.3 Requirements/Criteria for Institutions

The institution where training in neuro intervention is to be provided should have total beds in conformity with existing NBE norms [7].

The institute should have an in-house Neurology, Neurosurgery, and Neuroradiology set up. The requirement of minimum beds in parent super-specialty departments (Neurology/Neurosurgery) should be fulfilled [7].

The department should attend the minimum required patient load for the program as under [7]:

- *At least 100 Diagnostic Cerebral and Spinal Angiograms per annum.*
- *At least 50 Therapeutic Neurovascular Interventions per annum,* including the following:
  - Cerebral Thrombolysis—Arterial and Venous
  - Internal Carotid & External Carotid Angioplasty and Stenting

- Endovascular treatment of brain and spine Aneurysm
- Endovascular treatment of AVM, Dural fistulas and other malformations of brain and spine. Balloon test occlusion
- Pre-Op embolization
- Inferior Petrous sinus sampling
- Percutaneous embolization

17.2.3.4 Requirements/Criteria for the Program Personnel

The department should have *at least two full-time consultants*. One of them should be a Senior Consultant whereas the other consultant may be a Junior Consultant, meeting the criteria as outlined below:

Senior Consultant: Should have a *minimum of 5 years of exclusive experience* in neurovascular intervention *after having qualified* MCh/DNB/DM or equivalent post-doctoral qualification in either *Neurosurgery or Neurology or Neuroradiology*; alternatively, a *minimum of 10 years of exclusive experience* in neurovascular intervention *after having qualified* MD/DNB or equivalent in the specialty of *Radiodiagnosis*. The consultant should have supportive documentary evidence for his/her exclusive experience in the field of neurovascular intervention.

Junior Consultant: Should have a *minimum of 2 years of exclusive experience* in neurovascular intervention *after having qualified* MCh/DNB/DM or equivalent post-doctoral qualification in either *Neurosurgery or Neurology or Neuroradiology*; alternatively, a *minimum of 5 years of exclusive experience* in neurovascular intervention *after having qualified* MD/DNB or equivalent in the specialty of *Radiodiagnosis.* The consultant should have supportive documentary evidence for his/her exclusive experience in the field of neurovascular intervention.

Senior Residents: Two senior residents are *desirable* in the department. They must be in possession of a recognized degree qualification in the specialty of General Medicine or General Surgery or Radiology. The degree should not have been awarded more than 60 months earlier than the date of filing the application. Those in possession of an MCh/DNB/DM degree in Neurosurgery or Neurology or Neuroradiology shall be considered as senior residents in the department till they become eligible to qualify as Junior Consultants, i.e., upto 2 years post-MCh/DNB/DM [7].

The Indian system differs in that there is currently no central body to oversee the processes. This is bound to change in the near future as the training programs become more streamlined.

17.3 Conclusions

Training for neuroendovascular procedures is necessary for the safe conduct of procedures and to advance the field.

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