University of Colorado Health Sciences Center Neuroradiology Fellowship

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Welcome to the Program!

Welcome to the Neuroradiology Fellowship Program at the University of Colorado Health Sciences Center. The fellowship is a one or two year program during which the fellow will gain exposure and knowledge of all aspects of Neuroradiology. Exposure to Neuro-Interventional procedures will also be available, although not the focus of this program. We hope you have a productive and enjoyable year!
-Edward J. Escott, M.D.
Fellowship Director

Fellow Responsibilities

Welcome to the University of Colorado Health Sciences Center Neuroradiology Fellowship!!
Here are a few things you need to know.

The fellow is essentially responsible for overseeing the daily workings of the Neuroradiology clinical service, including supervision of the two residents (one resident in Neuroradiology, one on a neuro-MRI rotation). The fellow can utilize the resident in assisting with protocols, procedures, etc. dependant on the resident's skill and knowledge level.
Procedures. Angiograms, myelograms and biopsies. The fellow is expected to be involved in all, with or without a resident. (Generally in your first few months, without). Know the case ahead of time; obtain any films, lab results and relevant history. Specifically, know indications and contra-indications for procedure. Obtain consent. Be sure a pre-procedure note is written in the chart including all pertinent:
history, including allergies
lab values
relevant physical exam -pulses, pre-existing bruises, hematomas
neurologic- mental status, etc
Note that Medicare rules require that procedures are discussed in advance with faculty, faculty are present during procedure, and case reviewed with faculty prior to formal dictation. As we sometimes do not know the insurance status of a patient, we use that procedure for all cases, unless the faculty deems otherwise for a particular case. If faculty is not present for a procedure (e.g. lumbar puncture, set the paperwork aside for Staff assistant, and we will be careful to not place a professional charge for the procedure).
If faculty was present- then state in your dictation, if appropriate, that case reviewed with faculty before procedure, faculty member was present during procedure, and the case material, images, etc, was reviewed with faculty prior to formal dictation at end of procedure.

Protocols: All protocolling for scheduled MR and CT procedures should be done the day before, so that the ordering physician can be contacted with any questions BEFORE the patient arrives in the department. Check in the am to see if additional cases require protocol. The residents and fellows should attempt to protocol all studies first, then consult the attending with any questions. The MR techs are responsible for providing protocols for MR cases, and then consulting the fellow or attending for complex cases.

Late cases. Please be sure that no urgent or emergent cases are in progress or pending when you leave the department. If you do leave, please make sure that a responsible party (on-call or CT-call resident) will report the results to the ordering physician.
All ER cases need their results called immediately upon study completion. We can always call with a revised report when we read the study. You can tell them that this is a preliminary. Note on the request who you spoke with and when. Please be sure the

residents do this when checking cases as well. Jot down the impression you communicated to ordering physician.
Noon coverage. This will be shared between the fellow and attendings (residents, too if they don't have conference). Someone must remain in the department unless cross coverage is arranged.

Conferences

A. Brain tumor conference: (Tuesday 8:00 – 9:00a) This is a fellow/faculty responsibility. The conference is attended by neurosurgery, neuropathology, neuro-oncology, neuro-radiation therapy faculty, and fellows. Residents are encouraged to review these cases, but this is not their primary responsibility. Cases are often very complex. As such this is an excellent fellow-level conference. The fellow is expected to sort and pre-review the cases preferably beginning on the preceding Friday. The cases will be placed in the reading room on a CD ROM. Cases are then reviewed with the attending (typically on Monday). Occasionally these cases require dictations of outside films (by fellow).

B. The fellow is encouraged to attend other subspecialty conferences These include:

- ENT conference - Monday 7AM
- Neurology Grand Rounds - Wednesdays, 5 PM
- Pituitary conference - Wednesday AM, once a month
- Brain cutting-check with neuropath-the schedule varies - generally Friday afternoon

C. There are 4-5 GME/AFCGME required lectures on medical ethics, quality control, etc. Check with Cece Kurtz for times/dates-these are part of resident lecture series and are required. Please be sure to attend these and sign-in.

D. And of course, we wouldn't want to forget our Thursday morning case and QC conference.

Moonlighting is permitted, but cannot interfere with your regular responsibilities. You must obtain pre-approval and complete a standardized form (see Neuroradiology staff assistant-Bobby Quandt) for forms). See Housestaff Handbook for additional regulations.

Performance evaluations: GME requires routine evaluations of performance. We will evaluate you and vice versa quarterly. (please see section on evaluation) Forms are available and will be provided by Staff Assistant .
a. Quarterly review of fellowship by fellow. Quarterly review of fellow by faculty.
b. Take the Imaging examination on Neuroradiology web at the start of your fellowship and again at twelve months. Set a high standard for the residents to shoot for.

Other responsibilities and reading materials as in the resident responsibilities section. You also will probably want to occasionally peruse AJNR, which is available in our conference room.

Fellows are encouraged to become involved with faculty projects. They are also expected to contribute at least one case a month to the NeuroWeb teaching file.

Supervision: All imaging studies are reviewed by a faculty member at final readout.

Call: No more than 1 of 3 days or 7 of 21 days on average per month. Call is by beeper from home. All procedures will be supervised by faculty. Faculty backup is available at all times. Increasing independence is encouraged, as you feel more confidant in procedures.

Call and Weekend call--- Discuss procedures with faculty on call. Habits vary as to time and demands at readout sessions on weekends. All cases are reviewed daily by fellow or faculty or both. Notify faculty for all procedures. Imaging studies at your discretion. Call if unsure or complicated. Residents can perform unassisted, routine MR and of course CT-studies on call. Residents have the right to request assistance-call faculty if you are unsure how to handle any particular situation.

Vacation Request: All vacation days must be pre-approved. Please see Bobbie Quandt.

Hours: Routine readouts begin at 8-8:15 AM M-F. Cases should be reviewed and organized before the readouts begin. There is no end of the day, although the residents change shifts at about 4:30- 5pm if on call. Routine work usually is completed by 5-6 PM; check active cases before leaving department.

Duty Hours: We are in compliance with ACGME duty hours requirement. This is:
Duty hours must be limited to 80 hours per week, averaged over a four-week period, inclusive of all in-house call activities.
Residents must be provided with 1 day in 7 free from all educational and clinical responsibilities, averaged over a 4-week period, inclusive of call. One day is defined as one continuous 24-hour period free from all clinical, educational, and administrative activities. See ACGME website for further details.

Other: Dress codes, vacation, meetings, etc.as per GME Housestaff Handbook.

Fellowship Goals:

The following goals encompass the 6 clinical competencies as per the ACGME. (http://www.acgme.org/outcome/comp/compFull.asp)

I. Patient Care: Provide patient care that is compassionate, appropriate and effective.

The fellow should develop the following skills:

- Learn to gather essential, appropriate and accurate information about patient
- Learn to oversee diagnostic imaging procedures to ensure adequacy and appropriateness of studies performed
- Have an understanding of the tests being performed so that the fellow can have the ability to counsel patients concerning preparation for diagnostic testing
- Develop a basic understanding of electronic patient information systems
- Gain the ability to use the Internet as an educational instrument to expand medical knowledge
- Gain the knowledge of the levels of ionizing radiation related to specific imaging procedures and employ measures to minimize radiation dose to the patient
- Be able to perform radiologic examinations appropriately and safely, assuring that the correct examination is ordered and performed

II: Medical knowledge: Fellow will gain knowledge about established and evolving biomedical and clinical sciences and the application of this knowledge to patient care

Skills:

- Have a sufficient knowledge of medicine and apply this knowledge to radiological studies in a clinical context to generate meaningful differential diagnoses
- Have a progressive acquisition of radiological knowledge
- Gain knowledge of the principles of research design and implementation
- Gain the ability to use all relevant information resources to acquire evidence-based data
- Learn how radiological equipment can be used to generate appropriate and diagnostic Images

In addition, the fellow should:

Achieve a comprehensive understanding of all areas of neuroradiology including:
- Brain - normal anatomy and pathology imaging
- Spine and spinal cord - normal anatomy and pathology imaging
- Head and neck - normal anatomy and pathology imaging
Fulfill requirements for CAQ; see CAQ list.
Improve skills to a level of comfort with independence in procedures: Know indications, risks, complications of the following:

--Total, full dose myelography
--Low dose CT/myelography;
--Angiography:
-----Evaluation of carotid/vertebral/arch
-----Cerebral Angiogram: Aneurysm, AVM, WADA
Familiarity with pituitary sampling and neurointerventional procedures-particularly indications, risks
Scrub in with Dr. Kumpe and Dr. Huddle in a variety of Neuro-Interventional cases. Neurointerventional will be a separate fellowship. Familiarity rather than technical competence is the goal.

Adult Neuroimaging:
--The fellow will develop competency in interpreting imaging studies of the brain, spine, and "head & neck"
--The fellow will gain knowledge and understanding of the neurologic diseases affecting the adult population, and of the neoplasms affecting this population
--The fellow will understand the indications for the various neuroimaging studies, and be able to recommend the appropriate study and perform the appropriate study for a given clinical question

MR
--Knowledge of reasoning behind standard pulse sequences
--The fellow should be able to explain to the residents the basic sequence design
--Understand the basics of magnet design - surface coils vs. body coils
--Understand the basics of diffusion MRI
--Gain a very good understanding of MRA methods, why a particular approach is utilized
--Know how to surface render/MIP/multiplanar reconstructions
--Understand MR contrast issues-safety, excretion,etc

CT
--CT Physics - be able to review with the residents the basic physics relevant to CT including safety (dosing) issues
--Learn how to perform image reconstruction
--Understand the basics of helical/spiral scanning

Peds-Neurimaging:
--Monthly Wednesday am pediatric Neuroradiology conference at TCH
--The fellow will spend every Wednesday morning at Children's Hospital
--The fellow will gain knowledge and proficiency in interpreting studies of the head, spine and vasculature of the pediatric patient
--The fellow will gain knowledge and proficiency in understanding the neurologic disease, neoplasms and congenital lesions found in this patient population.

Neuropathology
--The fellow will have the opportunity to attend brain cuttings
--Develop general knowledge of brain tumor histology(at neuro- tumor board conf).

--Knowlege of Literature-develop skills in critical reading of the neuroimaging literature
--Should routinely read AJNR, selected use of other journals (Neurology,neurosurg,etc)
--Regular Journal Club sessions will be held, with articles chosen by the faculty, but discussion led by the fellow

Research: Reseach is encouraged, but it is understood that gaining clinical competence is the goal of a 1 year fellowship. However, if a 2 year fellowship is pursued, a research project should be developed that can be completed by the end of the fellowship. Discuss with faculty.

Lectures: A fellowship provides an excellent opportunity for the fellow to develop 2 good lectures in an area of interest, that you will be able to build upon after fellowship.

III. Interpersonal and Communication Skills: Fellow must develop interpersonal and communication skills that result in effective information exchange with patients, patient family members, medical students, other residents, supervising faculty, referring physician, technologists, nurses and other members of the health care team.

Skills:

- Be able to provide a clear and informative written radiologic report including a precise diagnosis whenever possible, a differential diagnosis when appropriate, and recommended follow-up or additional studies when appropriate
- Provide direct communication to the referring physician or appropriate clinical personnel when interpretation reveals an urgent or unexpected finding and document this communication in the radiologic report
- Develop effective skills of face-to-face listening and speaking with physicians, patients, patient's families and support personnel
- Develop appropriate telephone communication skills
- Develop skills for obtaining informed consent, including effective communication to patients of the procedure, alternatives, and possible complications

IV: Professionalism: Demonstrate a commitment to carrying out professional responsibilities, adherence to ethical principles, and sensitivity to a diverse patient population

Skills:

- Demonstrate altruism (putting the interests of patients and others above own self interest)
- Demonstrate compassion: be understanding and respectful of the patients, patient families, and staff and physicians caring for patients
- Demonstrate excellence: perform responsibilities at the highest level and continue active learning throughout one's career
- Be honest with patients and all members of the health care team
- Demonstrate honor and integrity: avoid conflicts of interest when accepting gifts from patients or visitors
- Interact with others without discriminating on the basis of religion, ethnic, sexual or educational differences and without employing sexual or other types of harassment
- Demonstrate knowledge of issues of impairment (.i.e. physical, mental and alcohol and substance abuse), obligations for impaired physician reporting, and resources and options for care of self-impairment or impaired colleagues
- Demonstrate positive work habits, including punctuality and professional appearance
- Demonstrate an understanding of broad principles of biomedical ethics
- Demonstrate principles of confidentiality with all information transmitted during a patient encounter
- Demonstrate knowledge of regulatory issues pertaining to the use of human subjects in research

V. Practice based learning and improvement: Fellow must learn to be able to investigate and evaluate their patient care practices, and appraise and assimilate scientific evidence in order to improve their radiologic practices.

Skills:

- Learn to analyze practice experience and perform practice-based improvements in cognitive knowledge, observational skills, formulating a synthesis and impression, and procedural skills
- Learn critical assessment of the scientific literature
- Gain knowledge of and apply principles of evidence-based medicine in practice
- Learn to use multiple sources, including information technology to optimize life-long learning and support patient care decisions
- Be able to facilitate the learning of students, peers and other health care professionals

VI. Systems based practice: Gain an awareness and responsiveness to the larger context and system of health care and the ability to effectively call on system resources to provide optimal care

Skills:

- Gain the ability to design cost-effective care plans based on knowledge of best practices
- Gain knowledge of the sources of financing for U. S. health care including Medicare, Medicaid, the Veteran's Affairs and Department of Defense, public health systems, employer-based private health plans, and patient's own funds.
- Gain knowledge of basic health care reimbursement methods
- Gain knowledge of the regulatory environment including state licensing authority, state and local public health rules and regulations, and regulatory agencies such as Centers for Medicaid and Medicare Services (CMS) and Joint Commission for the Accreditation of Healthcare Organizations (JCAHO)
- Gain knowledge of basic practice management principles such as budgeting, record keeping, medical records, and the recruitment, hiring, supervision, and management of staff

Fellow Competencies and Evaluations

Fellows will be evaluated quarterly and receive written evaluation forms which will be reviewed with the Program Director.
The fellow will complete quarterly reviews of the program.

The fellow will be assessed on the 6 categories of "Competencies" as set forth by the ACGME outcome project (http://www.acgme.org/outcome/comp/compFull.asp). These consist of the following categories:

- patient care
- medical knowledge
- practice-based learning and improvement
- interpersonal and communication skills
- professionalism
- systems-based practice.

For a detailed description of the competencies, please see the AGME website: http://www.acgme.org/outcome/comp/compFull.asp

CAQ

(information from the American Board of Radiology Web Site (www.theabr.org) as of May 2003.

The Certificate

The oral examination in Neuroradiology will be offered annually to Diplomates in Radiology or Diagnostic Radiology. Diplomates in Radiation Oncology are not eligible. Successful candidates will be issued a ten year time-limited Certificate of Added Qualifications in Neuroradiology.

Application

Application for examination must be made in exact duplicate (2 original copies on prescribed forms which may be obtained from the ABR office). No photocopy or any other kind of copy will be accepted. These forms must be forwarded by the deadline of May 15, together with the current application fee (U.S. currency).

checks should be made payable to THE AMERICAN BOARD OF RADIOLOGY, INC.

Incomplete applications will not be accepted. The postmark affixed to the last item received to complete the application must be on or before the deadline date.

There is a non-refundable penalty fee of $400 for any applications postmarked between May 15 and May 31. No applications will be accepted after May 31 for the examination in that year.

All returned Checks and declined Credit Cards will be subject to a $100 processing fee.

In the event of withdrawal of an application, a portion of the fee may be refunded. An administrative fee will be retained.

Training Requirements

Candidates must successfully complete one year of fellowship training (after residency) in a Neuroradiology program approved for such training and accredited by the ACGME or by the RCPSC (Canada) and one year of practice or additional approved training (one third of that time) in Neuroradiology.

Fellowship training must be documented by letter from the Program Director. Practice experience must be verified by letter from the Chief of Service or Department Chairman.

Leaves of Absence

Leaves of absence and vacation may be granted to fellows at the discretion of the Program Director in accordance with local rules. Within the required period(s) of graduate medical education, the total such leave and vacation time may not exceed six calendar weeks (30 working days) for fellows in a program for one year.

Examination

This examination will consist of three categories:

1. Brain and its coverings

2. Skull base and ENT

3. Spine

The examination will be conducted by three different examiners and the primary test material will be shown in computerized format of selected cases. In order to successfully pass the examination, the candidate will be required to obtain a passing grade in all three sections.

No recording device of any kind may be used during the examination.

Candidates will have three consecutive opportunities to appear for and pass the examination. Failure to accept an appointment, or a cancellation of an appointment will count as one of the three opportunities.

Content of Oral Examination
Note: The listed content is not meant to be all inclusive.

1) Brain and its coverings

a. Intraaxial

primary and secondary neoplasm

infection

demyelinating and dysmyelinating disease

stroke

hemorrhage

congenital malformation

b. Extraaxial

neoplasm

infection

c. Vascular

arteriovenous malformation

aneurysm

d. Trauma

e. Degenerative disease/dementia

2) Skull Base and ENT

a. Pituitary

b. Temporal Bone

neoplasm

infection

trauma

c. Orbit

neoplasm

infection

trauma

d. Sinuses/Nasal Cavity

neoplasm

infection

trauma

e. Oral Cavity and Oropharynx

f. Larynx and Thyroid

3. Spine

a. Degenerative Disease

b. Disc Disease

c. Congenital Malformations

d. Epidural Disease

e. Intradural Disease

neoplasm

demyelinating disease

f. Vascular Malformations

g. Trauma

Reexaminations
Failures:
A candidate who fails the examination in Neuroradiology may be reexamined in one year. The reexamination fee in effect at that time must be submitted by a specified date to be scheduled for reexamination. Candidates for reexamination will have three examiners, one for each of the three categories.

Conditions:
A candidate who fails one category of the Neuroradiology oral examination will be considered a condition candidate. Condition candidates will be reexamined by two examiners. The candidate must pass the reexamination by both examiners to remove the condition.

The reexamination fee in effect must be submitted by a specified date to be scheduled for the next oral examination.

Condition candidates will have three consecutive opportunities to appear for and pass the conditioned portion of the examination. If after three opportunities the candidate fails to remove the condition, he/she must submit a new application and fee in effect at that time and repeat the entire Neuroradiology examination.

Appendix A

Program Requirements for Residency Education in Neuroradiology

In addition to complying with the Program Requirements for Residency Education in the Subspecialties of Diagnostic Radiology, programs must comply with the following requirements, which may in some cases exceed the common requirements.

I. Introduction

A. Definition and Scope of the Subspecialty

The body of knowledge and practice of neuroradiology comprises both imaging (plain film interpretation, computed tomography, magnetic resonance imaging, ultrasonography, nuclear radiology) and invasive procedures related to the brain, spine and spinal cord, head, neck, and organs of special sense (eyes, ears, nose) in adults and children. Special training and skills are required to enable the neuroradiologist to function as an expert diagnostic and therapeutic consultant and practitioner. In addition to knowledge of imaging findings, the resident must learn the fundamentals of pathology, pathophysiology, and clinical manifestations of the brain, spine and spinal cord, head, neck, and organs of special sense. The program must provide residents with an organized, comprehensive, and supervised full-time educational experience in the selection, interpretation, and performance of neuroradiologic examinations and procedures. The program must also provide residents with opportunities to conduct research in the field of neuroradiology.

The training program must provide the resident with the opportunity to develop, under supervision, progressively independent skills in the performance and interpretation of neuroradiologic imaging studies and invasive procedures. At the culmination of training, the resident should be capable of independent and

accurate clinical decision making in all areas of neuroradiology.

B. General Information

The program shall offer 1 year of graduate medical education in neuroradiology. All of the program components specified in the Program Requirements must be offered in the first year, which is the year that is accredited. Prerequisite training for entry into a diagnostic radiology subspecialty program should include the satisfactory completion of a diagnostic radiology residency accredited by the Accreditation Council for Graduate Medical Education (ACGME) or the Royal College of Physicians and Surgeons of Canada (RCPSC), or other training judged suitable by the program director.

II. Faculty Qualifications and Responsibilities

A. Program Director

The program director must be certified by the American Board of Radiology in diagnostic radiology or radiology, or possess appropriate educational qualifications, and shall have a certificate of Added Qualifications in Neuroradiology. The program director must be a credentialed member of the radiology faculty and must spend at least 80% of his or her clinical and academic time in neuroradiology. The program director shall select and supervise the residents and select other neuroradiology faculty members. The program director shall perform quarterly reviews of the residents and obtain feedback from the residents on the program and the faculty.

B. Faculty

The neuroradiology faculty must include, in addition to the program director, one or more neuroradiologists who spend at least 80% of their time in the practice of neuroradiology. The faculty must provide teaching and supervision of the residents' performance and interpretations of neuroradiologic procedures.

C. Faculty/Resident Ratio

The total number of residents in the program must be commensurate with the capacity of the program to offer an adequate educational experience in neuroradiology and not to have a negative impact on the core diagnostic radiology program. The minimum number of residents need not be greater than one, but two or more residents are desirable. To ensure adequate supervision and evaluation of a resident's academic progress, the faculty/resident ratio must be at least one full-time faculty person for each resident.

III. Facilities and Resources

A. Equipment and Space

The following equipment, which must be "state of the art," must be available: magnetic resonance scanner, computed tomography (CT) scanner, digital subtraction angiography equipment, a radiographic-fluoroscopic room(s) with tilt table suitable for performing myelography, ultrasound equipment with Doppler capability, and conventional radiographic equipment. Physiological monitoring must be available. There must be adequate facilities adjacent to or within

examination rooms, for storing supplies needed for the conduct of invasive neuroradiologic procedures. There must be appropriately trained nurses and technologists for these invasive procedures. A crash cart for emergency ventilation and cardiac life support must be available.

Adequate space for image display, interpretation of studies, and consultation with clinicians must be available. There must be adequate office space and support space for neuroradiology faculty/staff and residents.

The program should provide adequate office space and supplies and secretarial support for the conduct of research projects. Assistance with literature searches, editing, statistical tabulation, and photography should be provided.

B. Laboratory

The institution should provide laboratory facilities to support research projects.

C. Library

There should be ready access to a library of current general medical texts and periodicals. In particular, there should be periodicals and texts in the fields of neuroradiology, diagnostic radiology, head and neck radiology, neurology, neurosurgery, neuroanatomy, physics, neuropathology, otolaryngology, neurophysiology, and orthopedic surgery. Computerized literature search facilities and Internet access must be available. A film-based , web-based, or electronic neuroradiology teaching file containing or providing access to a minimum of 500 cases must be available for use by the neuroradiology residents.

The available teaching material should be enhanced with new cases when appropriate.

IV. Educational Program

A. Curriculum

The program must offer the opportunity for residents to perform and interpret noninvasive and invasive diagnostic and interventional procedures under supervision. The procedures shall include diagnostic catheter-based cerebral angiography; other percutaneous minimally-invasive procedures (image-guided biopsies, spinal canal access for myelography, spinal fluid analysis, and medication installation); CT; MRI; MR/CT angiography; ultrasound of the central nervous system (including its vascular structures); plain film radiography related to the brain, head (including organs of special sense), skull base, and neck and spine; and nuclear medicine studies of the central nervous system. MR techniques such as magnetic resonance spectroscopy, functional activation studies, diffusion, and perfusion imaging should be incorporated into the training program. Residents must be given graduated responsibility in the performance and interpretation of the noninvasive and invasive procedures. Responsibility for these procedures should include pre- and postprocedural patient care. The resident must be thoroughly familiar with all aspects of administering and monitoring sedation of the conscious patient. They also must have advanced cardiac life support training and certification.

B. Clinical Components

The program in neuroradiology must provide a sufficient volume and variety of patients with neurological, neurosurgical, ophthalmologic, otorhinolaryngologic, spinal, and other pertinent disorders so that residents gain adequate experience in the full gamut of neuroradiologic examinations, procedures, and interpretations. The neuroradiology training program should provide a minimum number of procedures per year as follows:

1. 2500 total examinations (including plain radiographs, CT, MR, ultrasound, catheter angiograms, and image-guided invasive procedures). Of these 2500 examinations, there should be at least
    a. 1000 neuroradiological CT scans ;
    b. 1000 neuroradiological MR scans.
2. Residents must have participated in and documented the following:
    a. At least 50 catheter-based angiographic procedures.
    b. At least 50 image-guided invasive procedures (CT, MR, or fluoroscopically guided).
    c. Participation in at least five intracranial microcatheter procedures is highly recommended.

3. The 12 month training program must consist of at least
    a. 4 weeks or equivalent dedicated training in pediatric neuroradiology.
    b. 4 weeks or equivalent dedicated training in head and neck radiology.
    c. 4 weeks or equivalent dedicated training in spine radiology including image-guided procedures.
    d. 6-8 weeks or equivalent dedicated training in vascular neuroradiology. During this period there should be a special

emphasis on catheter neuroangiography. Experience in microcatheter techniques for thrombolysis treatment of acute stroke is strongly recommended. The program must offer the opportunity for residents to perform and interpret noninvasive and invasive diagnostic catheter-based cerebral angiography, other percutaneous minimally invasive procedures (image-guided biopsies, spinal canal access for myelography, spinal fluid analysis, and medication installation), CT, MRI, MR/CT angiography, ultrasound of the central nervous system (including its vascular structures), and plain film radiography related to the brain, head (including organs of special sense), skull base, neck, and spine.

e. Twenty-four to twenty-six weeks or equivalent dedicated training in general adult diagnostic neuroadiology.

C. Conferences

Residents must participate in one or more weekly departmental conferences in neuroradiology and one or more interdepartmental conferences with allied clinical departments (eg, neurology, neurosurgery, orthopedic surgery, neuropathology, head and neck surgery, and ophthalmology), as well as institutional conferences in clinical neurosciences (eg, grand rounds) that are held at least monthly. Residents should be encouraged to attend and participate in local extramural conferences and should attend at least one national meeting or postgraduate course in neuroradiology while in training.

Residents should be encouraged to present the radiological aspects of cases that are

discussed during daily work rounds and in clinical conferences related to allied disciplines such as neurosurgery and the neurological sciences. They should also prepare clinically or pathologically proved cases for inclusion in the teaching file.

There must be daily interpretation sessions requiring residents to reach their own diagnostic conclusions, which must then be reviewed by faculty. Diagnostic reports generated by residents should be closely reviewed for content, level of confidence, grammar, and style. Feedback must be provided and the reports must be signed by a neuroradiology staff physician.

The residents are required to maintain documentation (procedure log) of the invasive cases that they have performed. The program director must review the log with the resident at least quarterly.

Residents should be encouraged to participate in the teaching of diagnostic radiology residents and medical students, including the presentation of at least one didactic lecture.

D. Other Required Components

1. Resident participation in research

The residents should learn the fundamentals of experimental design, performance, and interpretation of results. They should participate in clinical, basic biomedical, or health services research projects and should be encouraged to undertake at least one project as principal investigator. They should submit at least one scientific paper or exhibit to a regional or

national meeting. The opportunity also must be provided for residents to develop their competence in critical assessment of new imaging modalities and of new procedures in neuroradiology.

2. Duty hours and conditions of work (See Program Requirements for Residency Education in the Subspecialties of Diagnostic Radiology for details concerning duty hour requirements.)

3. Interchange with students and residents in other specialties

Neuroradiology residents should be encouraged to participate in the research projects of staff persons and residents in other specialties. They should attend clinical conferences in other specialties and serve as consultants to these conferences. It is desirable that they participate in the clinical teaching of medical students and also in the preclinical curriculum in subjects such as neuroanatomy and neurophysiology.

V. Evaluation of Residents, Faculty, and Program

(See Program Requirements for Residency Education in the Subspecialties of Diagnostic Radiology for details concerning evaluation requirements.)

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