Advice to Medical Students Studying Neurology

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In most medical schools, students learn about the anatomy, physiology, pharmacology, and pathology of the nervous system during the *preclinical* portion of the curriculum (Year 1–2), and about the diagnosis and treatment of patients with neurological diseases during the *clinical* portion (Year 3–4).

Some schools cover neuroanatomy in a general anatomy course, neurophysiology in a general physiology course, and so forth, whereas many schools have a neuroscience course or sequence that covers all these topics.

Most schools have a required neurology clerkship in the third or fourth year, but in some schools neurology is instead offered as an elective. Most neurology clerkships last four weeks, but some last two or three weeks, and a few last longer than four weeks. In some schools, clinical training in neurology is combined with training in one or more related clinical specialties (e.g., psychiatry, neurosurgery) in a longer clerkship. In some schools, the pre-clinical neuroscience curriculum and clinical neurology clerkship are organized and taught by the same faculty; in other schools, they are independent of each other.

Regardless of your ultimate career path, you are likely to encounter patients with neurological problems, and you will need to know at least some basic principles of evaluation and management, if for no other reason than to recognize true emergencies. For many of you, your neurology clerkship will be your only sustained experience taking care of patients with neurological problems. In any case, it will be your first such experience. Below are five tips for making the most of the clerkship:

Preclinical Years

Inside the Classroom

Whether your school offers a comprehensive neuroscience course—or instead breaks up your neurology education over many different courses (pathology, neuoanatomy, etc.)—make the most out of your classroom time. Here are some tips from senior medical students and faculty that will help you succeed:

1. **Create a solid foundation in neuroanatomy**. Knowing the pathways and functions of systems will make learning neurological disorders and diseases much easier. Remember, neurology is a very logical discipline that emphasizes first localizing the lesion based on the clinical history and physical exam, and then determining the most likely diagnosis.
2. **Practice makes perfect**. Quiz yourself on pathways until it becomes second nature. Group study is often helpful, and web-based resources such as Utah Med have great online quizzes. (*http://library.med.utah.edu/kw/animations/hyperbrain/pathways/*)

3. **Read clinical vignettes**. Seeing or hearing about patients and their cases often makes it easier to remember the pathophysiology, diagnosis, and treatment of the disease.
4. **Spend extra time studying for boards**. High-yield board review books and study materials given out during board review courses will help you focus on what is most important for your board exams.
5. **Find other medical students who share your interest in neurology.**

Outside the Classroom

You can create great experiences, great connections, and great opportunities by exploring your interest in neurology outside the classroom. Some suggestions:

1. **Join** (or start!) **your medical school's SIGN chapter**. SIGN (Student Interest Group In Neurology) is a student-run organization at your school that collects all the latest information on how to get involved in neurology-related activities at your school. If it does not serve that function, then you should get involved in improving your chapter! Ask the Student Affairs department at your school, check the AAN website, or contact your neurology clerkship director to identify the contact person for SIGN at your school. Read the SIGN Reference Manual. (*http://www.aan.com/globals/axon/assets/3083.pdf*)
2. **Find a mentor**. Mentors are usually neurology faculty members (clinical or research) who can give you advice and guide you on your path towards becoming a neurologist. Choose a mentor who makes you comfortable, shares your interests, and has an interest in YOU. Get to know the neurology faculty at your medical school by attending Grand Rounds, resident teaching conferences, or SIGN events. You can also directly contact your neurology clerkship director or other faculty members who can help guide your learning.
3. **Shadow a neurologist**. Get a glimpse of a-day-in-the-life of your potential future profession, and probably learn some fascinating things along the way! Spending time shadowing a neurologist in the outpatient clinic or on the inpatient ward, or attending bedside teaching conferences (Neurology residents usually have bedside teaching conferences each week) are also helpful ways to solidify what you have learned.
4. **Consider doing research**. The summer between first and second years is often a very good time to introduce yourself to neuroscience research. Connect with researchers or research programs through your institution, or look for special funding opportunities for medical students conducting research on the AAN scholarships page. (*http://www.aan.com/?page=484.176.36*)
5. **Check out the AAN website**. **The Academy website offers** an impressive amount of opportunities and information at *www.aan.com* or *http://www.aan.com/go/education/students/medical* for information just for medical students.

Book List for Preclinical Years

Here are some resources that students have enjoyed reading in the preclinical years, used to prepare for board exams, or used for reference during their classes.

- *Netter's Atlas of Human Neuroscience*, David L. Felten, Ralph F. Józefowicz—Great resource for learning neuroscience for those who are visually oriented. Filled with Netter illustrations and organized by regional and systemic neuroscience sections.
- *Neuroanatomy: An Atlas of Structures, Sections, and Systems, 7th Ed*., Duane E. Haines—Superb human brain atlas with axial and coronal human brain sections and their CT and MRI correlates. Includes hundreds of USMLE style questions and blank pathway drawings on which to practice tracing tracts.
- *High-Yield Neuroanatomy, 3rd Ed*, James D. Fix—Excellent outline review of neuroanatomy with neurologic correlates. Good black-and-white diagrams along with CT and MRI images.
- *PreTest Neuroscience, 6th Ed*., Allan Siegel—Includes a brief (55-page) review of neuroscience, 500 USMLE style questions with thorough explanations. Good for reinforcing material and helpful for boards (STEP 1) preparation.
- *First Aid for the USMLE Step 1Boards, 2006.* V. Bhusan, T. Le—Excellent high-yield review of neuroanatomy, neurophysiology and neuropathology. Includes clinical pearls that are also tested on boards.

Clinical Years

Regardless of your ultimate career path, you will frequently encounter patients with neurological problems, and you will need to know at least some basic principles of evaluation and management, if for no other reason than to recognize true emergencies.

For many, your neurology clerkship will be your only sustained experience taking care of patients with neurological problems. In any case, it will be your first such experience. Here are five tips for making the most out of your clerkship.

1. Review Neuroscience

You may feel like you've forgotten all the neuroscience you learned as soon as you took the final exam, but you will be surprised by how quickly you can relearn it, especially the main points—and those points do come up regularly in patient care.

The first step in diagnosing neurological disease is to *localize the lesion* (see number 3 below), and for this you must remember at least a few major *nervous system pathways* and where they run.

Treatment decisions obviously require some understanding of *neurophysiology and pharmacology*. Review these topics before the clerkship if you can, and certainly review the topics that are relevant to any patient you see.

Experienced teachers in neurology, as well as medical students from numerous allopathic and osteopathic medical schools, *recommend the texts* listed below for review.

2. Learn the Neurologic Exam

Many students (and many physicians!) are intimidated by the neurology exam. As with other parts of the physical exam, the trick is to develop a *logical and systematic approach* that you can follow almost without thinking—and this takes practice.

The essential components of the neurologic exam include: *Mental Status, Cranial Nerves, Motor, Sensory, Reflexes (including Babinski), Coordination and Gait*. It is important to perform the exam in this order, as it will minimize the likelihood that you forget anything.

Your principal goal during the clerkship should be to learn to do a reliable *screening exam*. Your secondary goal should be to learn how to *supplement the exam with additional tests* when a patient's history or screening exam warrants it. You may wish to consult some of the books available on this topic; a few are listed below in Book List for Clinical Years below.

The neurology clerkship is the ideal time to get this practice, because you will be seeing many patients with both normal and abnormal findings. Abnormal findings will become more obvious with practice, and you will learn to recognize them via observing attending neurologists and residents perform the exam. Ask them to watch you examine patients, as they can then provide you with feedback on your technique and findings.

In order to perform a thorough and comprehensive neurologic exam, some *tools* are necessary. We suggest obtaining a *reflex hammer, tuning fork(s), eye chart, penlight, and sensory instruments* (e.g., single-use pins, monofilament, tongue depressors, or cotton-tipped sterile applicators). It will be very helpful for you to also have an *ophthalmoscope*, unless they are widely available at the bedside of your hospital, clinic, or school. A *stethoscope* is also very important (e.g. carotid and ophthalmic bruits). A *red object* (e.g., pen cap) is also helpful for evaluation for red color desaturation in one eye (e.g., when evaluating for optic neuritis or in patients with suspected multiple sclerosis). Many students also find it helpful to have an *NIH stroke scale* readily available and a pocket reference book with them in their lab coats. A list of some available books is also listed below.

3. Learn to Localize

With all medical problems, the first step in diagnosis is determining where the problem is. This can be especially tricky with neurological symptoms, because nervous system

pathways can run literally from head to toe. The tests you order (and the treatment you offer) will be very different depending on whether you think a patient's foot drop is caused (for example) by a brain tumor or peroneal compression at the knee.

For this reason, neurologists make a big deal about *neuroanatomical localization.* Whenever you present a patient on the neurology service, you should be prepared to answer the question, "Where's the lesion?" Localization is often difficult for medical students, and you should be sure to ask your instructors for help if you're having trouble. You may also wish to consult textbooks that cover this topic.

Review the major elements of localizing lesions:

- Upper motor neuron (UMN) vs. lower motor neuron (LMN)
- Ascending (e.g., dorsal column, spinothalamic) vs. descending (e.g. corticospinal) tracts
- Patterns of muscle weakness
- Actions of the cranial nerves
- General stroke territories

DO NOT stress about reviewing the ins and outs of pathophysiology and pharmacology. Review big-picture stuff—you will have plenty of opportunities to learn the details during your rotation.

4. Imagine You Were First on the Scene

Each time you begin a new clerkship, you face the daunting task of learning a new system, with new people, new procedures, new forms, and new expectations. Ask your clerkship director for an *outline of your expectations* while on the rotation. You must learn your role in the team, and do your part to facilitate efficient patient care.

With each patient you see, you should be sure to ask the patient (or caregiver/informant) how the symptoms started, and then ask yourself, "What would I have done if I had seen the patient at that point? Would I have realized the patient had a neurologic problem? What tests would I have ordered? What treatment would I have started?"

Students should take every opportunity to *interview and then examine the patient first, prior to looking at test results* or asking the supervising resident about the diagnosis. Try to localize the lesion based on your history and exam, and then generate a differential. Use your laboratory and ancillary studies (e.g., CT, MRI, EEG) to confirm your localization and differential.

It is important to realize that a well organized and methodological approach is essential for arriving at the correct diagnosis. A well trained physician will be able to arrive at the *correct neurologic diagnosis in over 80% of cases based on clinical history alone*. It should be your goal to arrive at the diagnosis without unnecessary tests that put the

patient at risk and overutilize costly hospital resources. Approaching clinical neurology in this way also helps to make solving the diagnostic puzzle fun and exciting.

Unless you choose neurology for your career, it is far less important for you to know how to treat a patient with refractory epilepsy than it is for you to know how to recognize seizures in the first place. You will probably never be responsible for treating brain tumors, but you are very likely to encounter patients with headaches, and you need to know how to distinguish benign headaches from those caused by structural diseases.

Ironically, many of the patients you see during your neurology clerkship will be far beyond the point of initial presentation. In most cases, by the time patients see a neurologist they have already been evaluated by one or more physicians and a neurological problem has been recognized.

In some cases, you will be seeing patients, whose diagnosis was determined long ago, who present for routine follow-up or for an acute management issue. For such patients, you must balance two objectives. On one hand, you want to do your part to help your team deliver efficient patient care. From this standpoint, questions about the patient's initial presentation and management may be irrelevant and time-consuming. On the other hand, you must remember to ask yourself such questions at some point, and if you don't know the answers, then you should ask your instructors (at an appropriate time, which may have to be after the patient interaction has ended).

5. Read, Read, Read

This advice applies to all of your clinical clerkships. Patient care is absorbing and time-consuming, and it is easy to become so caught up in it that you neglect to read. Indeed, time constraints may prevent you from ever having a block of several hours at a time to read a book in the usual way.

Instead, you may do much of your reading "on the fly." You should generally carry at least one textbook with you at all times, for use during those 15-minute "down periods" that occur unpredictably throughout the day. The *Massachusetts General Handbook of Neurology* and *Washington Manual of Neurologic Therapeutics* are excellent and commonly used.

A variety of textbooks are available. Most clerkships provide a list of required or recommended books. You should be sure to read about the topics relevant to the patients you are following. Of course, you will not have the opportunity to see patients with every possible neurological problem; over the course of the clerkship you will also need to learn about the entire spectrum of clinical neurology. An outline of the topics to cover is included in the "Neurology Clerkship Core Curriculum Guidelines," (*http://www.aan.com/globals/axon/assets/2770.pdf*) which has been adopted nationally.

Advice For Students Who Don't Have a Required Clerkship in Neurology

If your school does not require that you complete a neurology clerkship, using some of your *elective time on a neurology rotation* is the easiest way to learn the neurology that you need for the rest of your career. You should do this sooner rather than later, especially if you may be interested in applying for neurology residency.

Spending time on an *inpatient ward service* may be the most worthwhile, although if this is not possible, spending time as a member of the *neurology consult service* or in the *outpatient clinic* shadowing a neurologist are also reasonable options.

Talk to older students and your school's neurology faculty for advice about the best way to get involved in clinical neurology.

Advice For Students Searching For Advanced Training in Neurology

In addition to an introductory neurology clerkship, many schools offer the opportunity to *elect specialized or advanced training in neurology*, usually during the fourth year.

Examples include rotations on inpatient, consultation, or outpatient neurology services (often similar to the introductory clerkship, but with greater responsibilities and expectations for the student); rotations with a specialty service (e.g., a rotation with a neuromuscular service that includes time in the outpatient clinic), the EMG lab, and the consultation service; clinical research; or laboratory research.

In addition to the opportunities available in your own institution, you may wish to explore the possibility of doing an elective at another medical school. This is an excellent way to broaden your exposure to various styles of training and may help you later decide about which residency program is best suited for you.

Search the Clerkship Directory (*http://www.aan.com/students/clerkship/clerkship.cfm*)

After Your Clerkship

As you begin planning your career (trust us—this process will sneak up on you sooner than you think), you'll have to employ a whole host of resources to arrive at your goal (i.e., residency!). Here are *some resources to consider*:

Advanced 4th year electives. Explore your interest in neurology and get to know more neurologists. The AAN has a directory that includes clerkships across the country—find more details on the Clerkship page. (*http://www.aan.com/education/clerkship/*)

Career advisors. Find out if your school has assigned neurology mentors—or simply identify some for yourself!

The older and wiser. Upperclassmen, interns, and residents can be excellent sources of practical, need-to-know advice.

Keep perusing the AAN website. You can find a lot of helpful information on AAN.com, such as How to Find and Apply for a Residency in Neurology. (*http://www.aan.com/go/education/students/medical*)

Book List for Clinical Years

Looking for the right books for a clerkship can be a little overwhelming. Here are a few hints:

1. **Ask your fellow students who have done the rotation before.** Students at your school have probably adopted one or two books for each rotation that most people end up using. These are always safe choices, but always make sure they'll work for you.
2. **Consider holding off on that big textbook purchase until your internship.** Residency programs often endorse one in-depth textbook. And you may even score a free one!
3. **Go to the student bookstore and browse the books.** Get a sense of what's available. Think realistically about your goals for the rotation and how much reading material you will be able to cover.

Introductory texts that may be useful during your neurology clerkship

- Drislane FW, et al. *Blueprints in Neurology*. Blackwell Science, Inc. 2008. "Provides medical students with a reasonable compact review of neurology for practical use, attempting to clarify without oversimplifying."
- Gelb DJ. *Introduction to Clinical Neurology*, 2nd ed, Butterworth Heineman 1999. Was rated 3.86/5.0 on clerkship evaluations at Univ. of Iowa. Some students commented that "text lacks organization," while others "appreciated the clinical scenarios in each chapter." Some students said they would "prefer a text that is more concise, highlighting the main points."
- Simon RP, Aminoff MJ, Greenberg DA. *Clinical Neurology*, 4th ed. Lange. 1999. "An approach to neurology based on the presenting symptoms or signs, developed while teaching in the clinics and wards of the University of California, San Francisco."
- Weiner WJ, Goetz CG. *Neurology for the Non-neurologist*, 4th ed. Lippincott, Williams & Wilkins. 1999.

Pocket reference books that may be useful during your neurology clerkship

- Devinsky O, et al. *The Resident's Neurology Book*. FA Davis, 1997. An inexpensive paperback that is quite readable.
- Flaherty AW. *Massachusetts General Hospital Handbook of Neurology*. Lippincott, Williams & Wilkins, 2007. Excellent and comprehensive overview of hospital-based, inpatient neurology.
- Marshall RS & Mayer SA. *On Call Neurology*. WB Saunders, 1997.
- Neurology Pearls.
- Neurology Secrets.
- Samuels, MA. *Manual of Neurologic Therapeutics*, 7th ed. Lippincott Williams and Wilkins, 2004. Comprehensive and up-to-date spiral pocket guide with the latest in treatment options and concise discussion on diagnosis.
- Weiner HL, Levitt LP, Rae-Grant A. *Neurology* (House Officer Series), Lippincott, Williams & Wilkins.

Reference texts that may be useful during your neurology clerkship

- *Cecil's Essentials of Medicine*. Sections on neurologic disease and chapter on infections of the nervous system.
- Bradley WG, et al. *Neurology in Clinical Practice*, 5th ed. Butterworth-Heinemann. 2007. Two-volume set covering the approach to clinical neurology.
- Brust, JCM. *The Practice of Neural Science*. McGraw Hill, 2000. Casebook of approximately 100 cases of neurology problems. This is a "very helpful book for the transition into clinical neurology."
- *Harrison's Principles of Internal Medicine*. Neurology chapters.
- *Office Practice of Neurology*.
- Ropper, AH, Brown R Victor and Adams. *Textbook of Neurology*, 8th ed. McGraw Hill, 2006. Outstanding text, comprehensive, and often read by neurology residents.
- Rowland LP. *Merritt's Textbook of Neurology*. Lippincott, Williams & Wilkins, 2000. Outstanding text, comprehensive, and often read by neurology residents.

Review and/or question books for preparation for your board or shelf exams

- First Aid for the Neurology Clerkship.
- NMS Review Book.
- Underground Clinical Vignettes: Neurology, Classic Clinical Cases for USMLE Step 2 and Clerkship.

Online resources that may be helpful for your neurology clerkship

- American Academy of Neurology (*http://www.aan.com/*)
- E-medicine Neurology (*http://www.emedicine.com/neuro/index.shtml*)
- Up To Date (*http://www.uptodate.com/*)
- Washington University School of Medicine Links
  - The Washington University School of Medicine Neuroscience Tutorial (*http://thalamus.wustl.edu/course/*)
  - The Internet Stroke Center at Washington University (*http://www.strokecenter.org/images/*)
  - Department of Neurology, Washington University School of Medicine (*http://www.neuro.wustl.edu/education/clerkship.htm*)
- Whole Brain Atlas (*http://www.med.harvard.edu/AANLIB/home.html*)

Personal accounts of neurologic disease

- Albom M. *Tuesdays with Morrie*. An ALS patient is interviewed throughout the course of his illness
- Bauby J-D. *The Diving Bell and the Butterfly*. French journalist with "locked-in syndrome."
- Mairs N. *Waist High in the World*. A young woman wheelchair bound by multiple sclerosis.
- Reeve C. *Still Me*. Autobiography of actor paralyzed by C1-C2 injury (see particularly pp. 1-53 and 94-145 for his description of his disability and daily routine, and his emotional response).
- Sacks O. *The man who mistook his wife for a hat: And other clinical tales*.
- Schacter SC. *Brainstorms: Epilepsy in Our Words, Raven Press, 1993.*

Neurology curriculum references:

- *Charles, PD, Scherokman B, Józefowicz RF and the AAN Undergraduate Education Subcommittee. How much neurology should a medical student learn? A position statement of the AAN Undergraduate Education Subcommittee. Acad Med 1999;74:23-26.*
- *Gelb, DJ, Gunderson, CH, Henry, KA, Kirshner, HS, Józefowicz, RF. The neurology clerkship core curriculum.Neurology, Mar 2002; 58: 849-852.*
- *Isaacson, RS. Evaluating the Effectiveness of Continuum as a Teaching Tool for Residents and Medical Students: A Pilot Study. Neurology. 2008; 70 (suppl): A13.*
- *Isaacson, RS. Should there be a required Neurology clerkship during medical school? A pilot study. Neurology. 2007; 68 (suppl): A75.*
- *Scherokman B, et al and the AAN Undergraduate Education Subcommittee. What should a graduating medical student know about neurology? Neurology 1994:44:1170-1176.*

- *Steiner, SD, Barker, WW, Isaacson RS. Implementation of the 2006 American Academy of Neurology Parkinson Disease Practice Guidelines as a teaching curriculum improves medical student and resident evidence-based knowledge. Movement Disorders. 2006; 21 (suppl) 15:S458.*

Contributors: *Richard S. Isaacson, BA, MD, Chad Hales, MD, Jeremy Cholfin, Brynn Utley, Natalie Cheng, and Klarina Portnoy*

Read AAN's Clerkship Core Curriculum Guidelines (http://www.aan.com/globals/axon/assets/2770.pdf) for more information