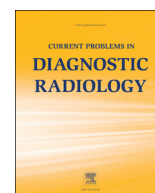




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Expectations of Medical Student Neuroradiology Education: A Survey of Practicing Neuroradiologists and Neurologists

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The purpose of this study is to evaluate which neuroradiological diseases neuroradiologists and neurologists believe medical students should be exposed to during their neuroradiology rotation. Members of the American Society of Neuroradiology (ASNR) and the American Academy of Neurology (AAN) were surveyed. Respondents were presented 32 diseases with neuroimaging findings and asked which ones medical students should be exposed to during a neuroradiology rotation. Using a 50% response threshold per disease entity, results were tabulated into 3 groups: diagnoses that (1) more than 50% of neuroradiologists and neurologists felt medical students should see radiologically by rotation completion, (2) less than 50% of respondents in both the groups felt were important, and (3) both the groups disagree are important. Both the groups thought medical students should be exposed to imaging of intraparenchymal hemorrhage (ASNR = 80.4% vs AAN = 84.3%; $P = 0.346$) and subarachnoid hemorrhage (ASNR = 74% vs AAN = 78%; $P = 0.394$). Both the groups (> 50%) thought subdural hematoma, acute ischemic stroke, epidural hematoma, and spinal cord compression are important. Conditions such as spine fractures, nonacute stroke, arteriovenous malformation, and ear-nose-throat pathology showed varied results between both the groups. Varying degrees of similarity and differences exist between the expectations of neuroradiologists and neurologists regarding medical student neuroradiology education, presenting a positive opportunity for greater consensus, dialogue, and joint curriculum formation.

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Introduction

At our institution, medical students have a dedicated neuro-radiology rotation as part of their neurology clerkship. However, we have noticed a lack of consensus in the literature addressing which neuroradiological diseases medical students should be exposed to during such a rotation. The Alliance of Medical Student Educators in Radiology (AMSER) curriculum has been published online by the Association of University Radiologists; however, this curriculum lacks detailed guidance for neuroradiology rotations.¹ Although numerous publications emphasize the importance of radiology education, there is no guidance for neuroradiology,^{2–16} and the focus is on methodology and delivery of medical student radiology education, rather than content.^{2–16} Others have examined the perception medical students have of their radiology experience during medical school and in their postgraduate year-1 internships.^{17–19} We believe that our study can serve as a complement to the existing AMSER curriculum and fill this gap in knowledge.

The purpose of this study is to identify similarities and differences among neuroradiologists and neurologists regarding which neuroradiological diseases medical students should see. We hope this study's results would lead to future alignment of expectations. Therefore, we would like this pilot project to inform others in the hopes of formulating larger, well-informed curricula.

Materials and Methods

Survey Distribution

Our Institutional Review Board exempted this Health Information Portability and Accountability Act-compliant study. The American Society of Neuroradiology (ASNR) and the American Academy of Neurology (AAN) e-mailed an online survey ([Appendix I](#)) to their members. We had no access to the organizations' membership list. On the survey, respondents were initially asked to indicate whether they were a neurologist or neuroradiologist. Subsequently, each respondent was presented a list of 32 diseases that have characteristic neuroimaging findings and was asked whether a medical student should be exposed to these diseases during their neuroradiology rotation. The list of 32 diseases was formulated after consensus of 2 neuroradiologists (F.H.C. and M.E.M.) and a neurologist (J.K.), all involved in medical student education. We did not offer an

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Table 1
Diagnoses where > 50% of both the respondent groups replied in the affirmative

| Diagnosis | AAN neurologist respondents | ASNR neuroradiologist respondents | % Difference | P value |
|-----------------------------|-----------------------------------|---|-----------------|------------|
| Intraparenchymal hemorrhage | 107 84.3% | 229 80.4% | 3.9 | 0.346 |
| Subarachnoid hemorrhage | 99 78.0% | 211 74.0% | 3.9 | 0.394 |
| Spinal cord compression | 99 78.0% | 176 61.8% | 16.2 | 0.001 |
| Acute ischemic stroke | 117 92.1% | 231 81.1% | 11.1 | 0.004 |
| Subdural hematoma | 118 92.9% | 241 84.6% | 8.4 | 0.019 |
| Epidural hematoma | 112 88.2% | 227 79.6% | 8.5 | 0.036 |

open response box because we felt the list of 32 diseases was comprehensive.

Incomplete surveys and those from self-identified neuroradiologist members of the AAN and self-identified neurologist members of the ASNR were excluded. The societies were not able to provide the total number of members to whom they sent surveys. Additionally, the societies could not provide information about the practice type of their members (eg, academic, practice, or hybrid).

Statistical Analysis

Counts and frequencies for each diagnosis were calculated. For each diagnosis, differences between neurologists and neuroradiologists were assessed for statistical significance using the chi-square statistic. The Pearson chi-square test of independence was used to calculate *P*-values comparing the percentage of neurologists and neuroradiologists answering in the affirmative for each diagnosis (*P* < 0.05 was considered statistically significant). Results were organized into 3 tables: (1) **Table 1** shows the diagnoses that more than 50% of neuroradiologists and neurologists felt medical students should be exposed to by the end of their neuroradiology rotation, (2) **Table 2** shows diagnoses that less than 50% of respondents in both the groups felt were important for medical students, and (3) **Table 3** shows those disorders that both

Table 2
Diagnoses where < 50% of both the respondent groups replied in the affirmative

| Diagnosis | AAN neurologist respondents | ASNR neuroradiologist respondents | % Difference | P value |
|-------------------------------------|-----------------------------------|---|-----------------|------------|
| Inner ear infection | 3 2.4% | 20 7.0% | 4.7 | 0.057 |
| Meningitis | 28 22.0% | 43 15.1% | 7.0 | 0.084 |
| Glioblastoma multiforme | 58 45.7% | 105 36.8% | 8.8 | 0.091 |
| Subfalcine herniation | 42 33.1% | 113 39.6% | 6.6 | 0.203 |
| Nasal polyps | 5 3.9% | 20 7.0% | 3.1 | 0.227 |
| Mastoiditis | 14 11.0% | 43 15.1% | 4.1 | 0.270 |
| Child abuse (neuroimaging findings) | 49 38.6% | 95 33.3% | 5.2 | 0.302 |
| Tonsillar herniation | 46 36.2% | 101 35.4% | 0.8 | 0.879 |
| Normal pressure hydrocephalus | 35 27.6% | 29 10.2% | 17.4 | < 0.001 |
| Acute sinusitis | 24 18.9% | 103 36.1% | 17.2 | 0.001 |
| Ruptured globe | 10 7.9% | 89 31.2% | 23.4 | ≤ 0.001 |
| Encephalitis | 32 25.2% | 37 13.0% | 12.2 | 0.002 |
| Subacute ischemic stroke | 46 36.2% | 65 22.8% | 13.4 | 0.005 |
| Otitis media | 3 2.4% | 28 9.8% | 7.5 | 0.008 |
| Orbital fracture | 18 14.2% | 73 25.6% | 11.4 | 0.010 |
| Orbital cellulitis | 9 7.1% | 47 16.5% | 9.4 | 0.010 |
| Arteriovenous malformation AVM | 44 34.6% | 65 22.8% | 11.8 | 0.012 |
| Nasal fracture | 7 5.5% | 37 13.0% | 7.5 | 0.023 |

Table 3
Diagnoses where the respondent groups remarkably differed

| Diagnosis | AAN neurologist respondents | ASNR neuroradiologist respondents | % Difference | P value |
|---------------------------|-----------------------------------|---|-----------------|------------|
| Obstructive hydrocephalus | 88 69.3% | 131 46.0% | 23.3 | < 0.001 |
| Prior ischemic stroke | 88 69.3% | 141 49.5% | 19.8 | < 0.001 |
| Cerebral edema | 84 66.1% | 87 30.5% | 35.6 | < 0.001 |
| Uncal herniation | 65 51.2% | 106 37.2% | 14.0 | 0.008 |
| Meningioma | 66 52.0% | 109 38.2% | 13.7 | 0.009 |
| Central herniation | 67 52.8% | 135 47.4% | 5.4 | 0.313 |
| Cervical spine fracture | 48 37.8% | 162 56.8% | 19.0 | < 0.001 |
| Unstable spinal fracture | 48 37.8% | 154 54.0% | 16.2 | 0.002 |

the groups disagree are important for medical students. We also tabulated the top 12 diagnoses in each group based on percentage of agreement (**Table 4**). Lastly, we compared the percentage of agreement between the top 12 ASNR diagnoses and the same diagnoses in the neurology group (**Table 5**).

Results

There were 129 respondents in the AAN group and 292 respondents from the ASNR group. There were 2 nonneurologists in the AAN group, 2 nonneuroradiologists in the ASNR group, and 5 incomplete surveys in the ASNR group that were excluded from the final analysis.

Most of the respondents from the AAN and the ASNR agreed that medical students should be exposed to intraparenchymal hemorrhage (ASNR = 80.4% vs AAN 84.3%; *P* = 0.346) and subarachnoid hemorrhage (ASNR = 74% vs AAN = 78%; *P* = 0.394) (**Table 1**). Additionally, a statistically significant, larger proportion of neurologists felt that medical students should be exposed to imaging of subdural hematoma, acute ischemic stroke, epidural hematoma, and spinal cord compression; however, both the groups had > 50% of respondents favoring seeing these conditions (**Table 1**).

In both the groups, nontraumatic ear-nose-throat diagnoses and subfalcine and uncal herniation were selected by less than 50% of respondents (**Table 2**). In addition, **Table 2** shows that more neurologists felt that medical students should see imaging of subacute ischemic stroke, normal pressure hydrocephalus, arteriovenous malformation, and encephalitis. Alternatively, more neuroradiologists felt that orbital trauma and orbital infection, nasal bone fracture, and acute sinusitis should be seen.

Lastly, a set of unrelated diagnoses were shown to have statistically significant disagreement, with neurologists favoring the nontraumatic disorders (prior ischemic stroke, obstructive hydrocephalus, cerebral edema, meningioma, and uncal herniation) and neuroradiologists favoring exposure to spinal trauma (**Table 3**).

We also tabulated the top 12 diagnoses in each group (**Table 4**). We again found that both the groups recommended intracranial hemorrhage (eg, epidural, subdural, and intraparenchymal) and spinal cord compression. There was variability about types of herniation syndromes, spinal fractures, meningioma, and hydrocephalus.

When comparing the top 12 ASNR diagnoses and the same diagnoses in the AAN group, we found multiple statistically significant differences in percentage of agreement between both the groups (**Table 5**).

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