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NEUROLOGY IN PRACTICE

Neurointervention rotations and comfort with clinical decision-making in stroke and neurocritical care: A nationwide survey of Indonesian neurology trainees

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Abstract

Background & Objective: Cerebrovascular diseases are among the most frequently managed conditions in neurology residency. With advances in reperfusion and endovascular therapies, exposure to neurointervention has become increasingly relevant in residency training. However, neurointervention rotations are not uniformly implemented across Indonesian training centers. This study aimed to explore neurology trainees' perspectives on neurointervention rotations and to evaluate

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whether participation in such rotations influences comfort with clinical decision-making in stroke and neurocritical care. *Methods:* An electronic survey was distributed in early 2025 to 15 neurology residency training centers across Indonesia. Neurology trainees were randomly selected from each participating center to complete the questionnaire. The survey, adapted from previous studies, assessed demographics, exposure to neurointervention, and comfort with clinical decision-making using a five-point Likert scale. All responses were collected anonymously to ensure confidentiality. *Results:* Of 120 invited residents, 116 (96.7%) completed the survey. Neurointervention rotations were offered at 11 centers, completed by 66 (56.9%) respondents. Most trainees (83.6%) believed such rotations should be mandatory. Residents who had completed a neurointervention rotation reported significantly greater comfort in identifying large vessel occlusion ($p=0.003$), interpreting cerebral angiograms ($p<0.001$), determining Thrombolysis in Cerebral Infarction score ($p=0.018$), and managing intracerebral and subarachnoid hemorrhage in stroke units ($p=0.02$).
Conclusion: Neurovascular and neurocritical care rotations provide a foundation for clinical decision-making in stroke. However, dedicated neurointervention rotations significantly improve trainees' comfort in managing hyperacute stroke and neurointervention-related cases, and may also encourage pursuit of fellowship training. Standardizing such rotations across training centers could better prepare residents for the complex decision-making required in modern stroke and neurocritical care.

Keywords: Clinical decision-making, education, neurointervention, residency

INTRODUCTION

Cerebrovascular diseases are the most frequently managed conditions in neurology wards during residency training.[1,2] With ongoing advances in the field, the management of stroke has progressed rapidly. Current guidelines recommend reperfusion therapy—thrombolysis and thrombectomy—as the standard treatment for hyperacute stroke.[3–5] In hemorrhagic stroke, particularly aneurysmal subarachnoid hemorrhage (SAH), endovascular treatment has become central, with coiling as the first-line option.[6] Moreover, recent evidence demonstrates the benefits of endovascular approaches for hemorrhagic stroke caused by vascular malformations, including arteriovenous malformations (AVM) and dural arteriovenous fistulas (DAVFs).[7,8]

The growth of neurointervention within neurology has increased residents' exposure to endovascular cases.[9] As this subspecialty continues to evolve rapidly, it is essential to understand residents' perspectives on neurointervention training. A structured rotation—for example, a mandatory four-week program during residency or fellowship—could broaden exposure, better prepare trainees for the demands of the field, and strengthen workforce capacity.[10–12] Academic centers with neurology-trained neurointerventionists are also well positioned to attract and train more residents in this area.[9–11]

In Indonesia, interventional neurology is a relatively new discipline, pioneered by a neurologist in 2010. At present, all neurology residency training centers in the country have practicing neurointerventionists.[13] However, a dedicated neurointervention rotation is not uniformly mandatory across centers. Ongoing debate remains among neurology educators regarding the urgency of mandating such a rotation and the optimal structure for its implementation.

This study aimed to explore neurology trainees' perspectives on neurointervention rotations and to evaluate whether participation in such rotations influences their comfort with clinical decision-making in stroke and neurocritical care. To our knowledge, no prior educational surveys have addressed this issue in Indonesia. This study therefore seeks to fill this gap by providing nationwide data on trainees' perceptions and experiences.

METHODS

A research questionnaire developed by the Neurointervention Working Group of the Indonesian Neurological Association was distributed to 15 neurology residency training centers across Indonesia in May 2025. The electronic survey, created in Bahasa Indonesia, was adapted from previously published questionnaires.[11,12] It consisted of three sections: (1) demographic data (age, sex, level of supervision, and duration of training), (2) exposure to neurointervention, and (3) comfort with clinical decision-making in emergency units, angiography suites, and stroke units. All responses were anonymous, and informed consent was obtained prior to participation.

Institutional Review Board approval was waived for this study as it did not involve patient participation or the collection of identifiable personal data.

The principal investigator uploaded the questionnaire to Google Forms and disseminated it to representatives at each training center. At each center, eight residents were randomly selected to complete the survey. Responses remained anonymous, and only the principal investigator had access to the data. In section three, respondents rated their comfort with clinical decision-making using a five-point Likert scale, where 1 indicated "very uncomfortable" and 5 indicated "very comfortable."

Data were analyzed using SPSS version 30.0 (IBM Corp, Armonk, USA). Descriptive data were summarized in frequency tables and diagrams. Scores from section three (comfort with clinical decision-making) were compared between residents who had completed a neurointervention rotation and those without such a rotation. Depending on the data type, group comparisons were performed using either Fisher's exact test or the Mann–Whitney U test. A p-value <0.05 was considered statistically significant.

RESULTS

Demographic data

Fifteen neurology residency training centers participated in this study. Of the 120 residents invited, 116 (96.7%) completed the questionnaire. Most respondents were aged ≥30 years, had been in training for at least three years, and reported practicing independently under indirect supervision. The demographic characteristics of the respondents are summarized in Table 1.

All neurology training centers included dedicated rotations in Neurovascular and Neuroemergency and Critical Care. Ten centers offered a one-month neurovascular rotation, while five centers offered three months. For Neuroemergency and Critical Care, 13 centers provided a one-month rotation and two centers provided three months.

Neurointervention rotations were available at 10 centers, each with a duration of one month. One center combined the neurovascular and neurointervention rotations into a single three-month program, while four centers did not offer any neurointervention rotation.

Among all respondents, 66 (56.9%) had completed a neurointervention rotation, 18 (15.5%) had not yet completed the rotation, and 32 (27.6%) were enrolled at centers without such a rotation. Overall, 97 residents (83.6%) believed that a neurointervention rotation should be mandatory to strengthen knowledge and skills in this field, whereas 19 (16.4%) felt that it should remain elective for those with specific interest.

When asked how exposure and training could be improved, 58 residents (50.0%) recommended making the rotation mandatory, 41 (35.3%) suggested adding an additional elective of 3–4 weeks, 14 (12.1%) stated that the current program was sufficient, and 3 (2.6%) did not provide an answer.

Tabel 1: Respondent demographic data

Demographic data (n=116)	N(%)
Gender	
Male	57 (49.14)
Female	59 (50.96)
Age (year)	
Range	27 – 38
Mean ± SD	32.17±2.71
Supervision level	
Direct supervision (Junior)	5 (4.31)
Indirect supervision with direct supervision Immediately available (Middle)	27 (23.28)
Indirect supervision (Senior / Chief)	84 (72.41)
Length of training (year)	
Range	1-5
Mean ± SD	2.99±0.69
Neurointervention exposure during education	

Table 2: Neurology trainee perspective on neurointervention rotation (n=66)

Statement	Response	n(%)
As a neurology resident, I felt appreciated during my neurointervention rotation, whether in the angiosuite as an observer or while participating in neurointervention procedures	Strongly agree	34 (51.5)
	Agree	29 (43.9)
	Neutral	3 (4.5)
	Disagree	0 (0)
	Strongly disagree	0 (0)
Completing the neurointervention rotation made me interested in pursuing a fellowship or further studies in neurointervention	Strongly agree	26 (39.4)
	Agree	19 (28.8)
	Neutral	21 (31.8)
	Disagree	0 (0)
	Strongly disagree	0 (0)
My educational center has adequately prepared me for undertaking the neurointerventional fellowship	Strongly agree	24 (36.4)
	Agree	26 (39.4)
	Neutral	14 (21.2)
	Disagree	2 (3.0)
	Strongly disagree	0 (0)

Of the 66 residents who had completed a neurointervention rotation, 51 (83.3%) reported being allowed to enter the angiography suite, while 11 (16.7%) observed procedures only from outside. Most trainees felt valued during their rotation and expressed interest in pursuing a neurointerventional fellowship after graduation (Table 2).

We compare the residents' comfort level in clinical decision-making from those who had completed the neurointervention rotation (n=66) with those who have no neurointervention rotation in their educational center (n=32). We excluded the residents who had not completed the neurointervention rotation because most of them had lower supervision level, which may impact the comfortability with clinical decision making.

Between these two groups, there were no significant difference in the supervision level (p=0.640) and training duration (p=0.550). Based on residents' comfort levels in clinical decision-making, those who had completed a neurointervention rotation reported significantly higher comfort in determining large vessel occlusion (p = 0.003), interpreting cerebral angiograms (p <0.001), assessing the Thrombolysis in Cerebral Infarction (TICI) score (p = 0.018), and managing intracerebral hemorrhage and subarachnoid hemorrhage in the stroke unit (p = 0.02) (Figure 1).

DISCUSSION

This survey highlights the growing importance of neurointervention rotations in neurology residency programs across Indonesia. Our findings showed that not all training centers currently provide such rotations, a result consistent with previous studies indicating that not all trainees receive adequate exposure to neurointervention.[10–12] Several factors may contribute to this gap, including a shortage of dedicated interventional neurologist faculty, low case volumes, and limited time for mentorship.[10] In some institutions, the angiography suite is shared among multiple specialties, which may restrict access to neurointervention cases and discourage the implementation of a dedicated rotation. In addition, differences in the flagship programs of individual training centers may influence whether neurointervention is formally integrated into residency curricula.

Most respondents agreed that a neurointervention rotation should be mandatory to enhance their knowledge and strengthen their skills in this field. Establishing a dedicated neurointervention rotation, separate from neurovascular and neuroemergency rotations, would provide residents with structured exposure to this rapidly evolving subspecialty. Such rotations could include hands-on experience in the angiography suite, clinical training in neurovascular intensive care units and wards, as well as simulation-based learning

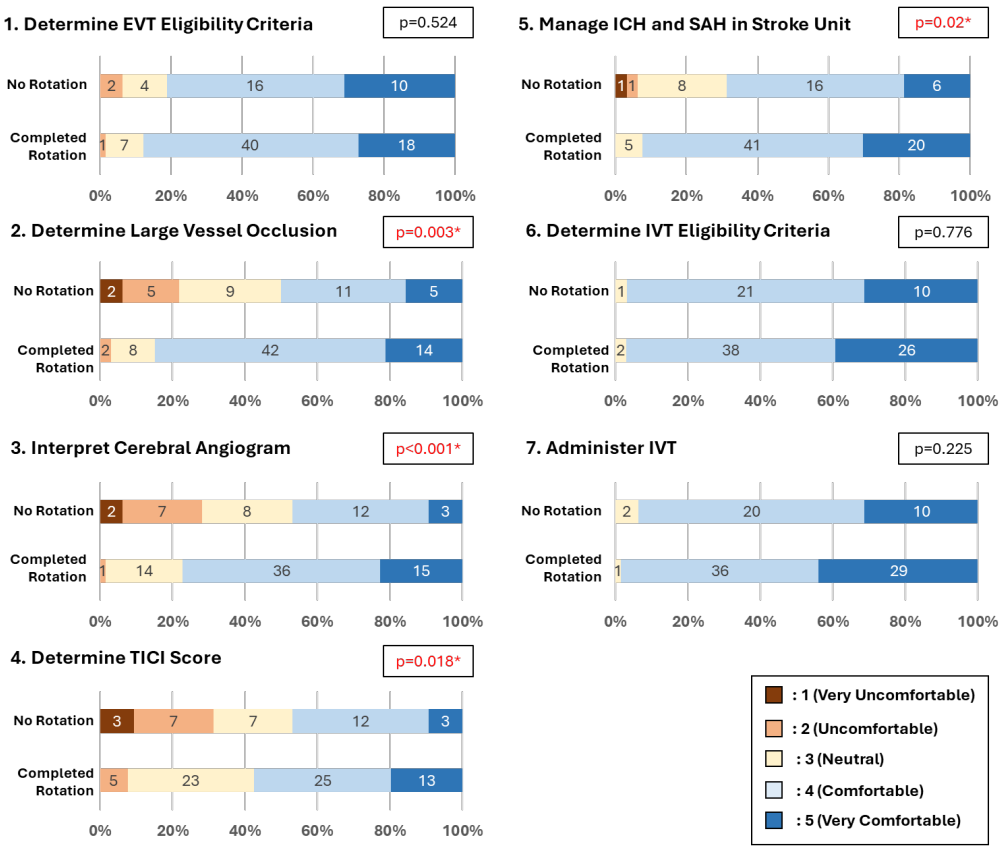

Figure 1. Comparison of clinical decision-making comfort between residents who completed a Neurointervention Rotation and those without neurointervention rotation. Note: Using Fisher-Exact Test; *significant for p<0.05, EVT = Endovascular Therapy; ICH = Intracerebral Hemorrhage; IQR = Interquartile Range; IVT = Intravenous Thrombolysis; SAH = Subarachnoid Hemorrhage; TICI = Thrombolysis in Cerebral Infarction

and bench models to familiarize residents with the devices and techniques used in routine practice.[12] Notably, many respondents who had completed a neurointervention rotation reported increased interest in pursuing fellowship training and felt that their institutions had prepared them adequately. Direct participation in the angiography suite also allows residents to develop both technical and cognitive skills, which are essential for those considering fellowship training in neurointervention.[10] For centers without neurointervention rotations, offering a four-week elective at institutions with established programs may help address the gap in exposure.

Our data further showed that neurovascular and neurocritical care rotations generally equip neurology trainees with the skills needed for clinical decision-making in hyperacute stroke. However, trainees who had completed a neurointervention rotation reported greater confidence and demonstrated an advantage in tasks such as identifying large vessel occlusion, interpreting cerebral angiograms, determining TICI scores, and managing SAH and ICH in the stroke unit. Beyond procedural exposure, these trainees were also engaged in a variety of clinical responsibilities and academic activities, such as case discussions and journal clubs, which further strengthened their cognitive skills. By integrating hands-on training, clinical duties, and academic activities, neurointervention rotations play a pivotal role in developing both technical skills and cognitive abilities, ultimately equipping trainees to handle the complex clinical decision-making demands of modern stroke and neurocritical care.[10]

To our knowledge, this is the first nationwide survey in Indonesia evaluating neurology trainees' perspectives on neurointervention

rotations. These findings are important, as regional differences in interventional neurology policies may shape trainees' perceptions and influence their interest in pursuing a career in this field.

Nonetheless, several limitations should be acknowledged. First, our data were self-reported by trainees and did not include objective or quantitative measures such as academic performance, number of cases managed, or curriculum details. As a result, our findings should be interpreted with caution. Second, we did not collect follow-up data on whether respondents ultimately pursued neurointervention fellowships after graduation. Future longitudinal studies are needed to assess the impact of neurointervention rotations on trainee performance during fellowship and subsequent career development.

In conclusion, our study highlights the importance of incorporating a neurointervention rotation into neurology residency training. While neurovascular and neuroemergency rotations are generally sufficient to prepare trainees for clinical decision-making in hyperacute stroke, the addition of a dedicated neurointervention rotation further enhances their confidence in managing these cases and provides a distinct advantage in handling neurointervention-specific scenarios. A structured neurointervention rotation not only strengthens both technical and cognitive competencies but also better prepares trainees who wish to pursue a career in neurointervention.

DISCLOSURE

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