

Original Article

Hands-on neuroendovascular practice for nonselective undergraduate medical students increases interest and aspirations in pursuing neurosurgery as a specialization

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ABSTRACT

Background: The number of medical students aspiring to become neurosurgeons has decreased worldwide, mainly due to poor work-life balance among neurosurgeons; therefore, recruiting students for neurosurgery is essential to ensure the availability and appropriate quality of neurosurgical treatment. This study aimed to evaluate the efficacy of hands-on neuroendovascular practice for nonselective undergraduate medical students to determine whether this increases their interest in neurosurgery and contributes to their aspirations of becoming neurosurgeons.

Methods: Hands-on neuroendovascular practice for mechanical thrombectomy was performed by undergraduate 5th-year medical students during their 2-week clinical rotation in the Department of neurosurgery at our university hospital between April 2021 and March 2023. After the neurosurgery practice, a questionnaire about their understanding of neurosurgery and aspirations for this specialization before and after the practice was anonymously completed by all students.

Results: Overall, 153 students completed the questionnaire. Of these, 140 (91.5 %) showed increased interest in neurosurgery after participating in the hands-on practice. Through this practice, the number of students who considered neurosurgery as their first choice or one of their specialty choices increased from 8 (5.2%) to 12 (7.8%) ($P = 0.3534$) and from 19 (12.4%) to 52 (34.0%) ($P < 0.0001$), respectively. Furthermore, the number of students with no aspiration to become neurosurgeons decreased from 95 (62.1%) to 43 (28.1%) ($P < 0.0001$).

Conclusion: Hands-on neuroendovascular practice for nonselective undergraduate medical students effectively increased their interest in neurosurgery specialization and their desire to become neurosurgeons. Therefore, this practice can help recruit medical students for neurosurgery specialization.

Keywords: Education, Endovascular, Hands-on practice, Medical students, Neurosurgery

INTRODUCTION

Neurosurgery has a wide range of subspecialties and is used in the treatment of a large number of patients. Neurosurgical operations include direct surgeries and endovascular treatments. Direct surgeries have traditionally been the mainstay; however, endovascular treatments have been increasingly performed in recent decades. Moreover, the importance of neuroendovascular

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treatments have been highlighted by evidence for thrombectomy as a treatment for acute ischemic stroke. While neuroendovascular treatments are primarily performed by radiologists or neurologists in some countries, in Japan, neurosurgeons mostly perform the treatments, including thrombectomy. Therefore, the role of neurosurgeons and the demand for neurosurgeons have been on the rise in Japan.

Recruiting medical students for neurosurgery is essential for sufficient human resources to continue providing high-quality neurosurgical care. However, poor work-life balance and high rates of burnout among neurosurgeons are common concerns for physicians entering this specialty, and these can be largely attributed to aging in society and the burdens of neuro surgeries such as thrombectomy, which require prompt treatment.^[9,10,14-16] Work-life balance has been emphasized as a concern among medical students, and they tend to apply to clinical departments with lifestyle-friendly specialties such as radiology, dermatology, and ophthalmology, whereas few students aspire to become neurosurgeons.^[2,3,4,8,12,18] Therefore, educational programs to increase students' interest in neurosurgery are needed.

Medical education mainly consists of classroom lectures and bedside learning (BSL), with differences among countries and regions. In Japan, the medical university program consists of a 6-year program, and clinical practice typically commences during the 4th or 5th year. Our medical university was established in 2017, and the first batch of medical students graduated in 2023. According to the educational curricula of our university, 1–3rd-year medical students mainly attend classroom lectures, basic laboratory practicals, and anatomy practice, whereas 4th- and 5th-year medical students undergo BSL through practical training at university hospitals. In the Department of neurosurgery at our university hospital, hands-on neuroendovascular practice for mechanical thrombectomy is conducted for all students in addition to conference participation, lectures, surgery observations, and report writing. In the present study, we evaluated the effectiveness of this hands-on practice for nonselective undergraduate medical students, including those not interested in neurosurgery, to determine whether it increases their interest in neurosurgery and contributes to their aspirations of becoming neurosurgeons.

MATERIALS AND METHODS

Fifth-year medical students in groups of six or seven underwent a 2-week clinical rotation in the Department of Neurosurgery at our university hospital. The targeted students were the first batch who underwent BSL, including hands-on neuroendovascular practice, between April 2021 and March 2022 and the second batch who underwent the practice between April 2022 and March 2023. This study did not include patient information; therefore, the institutional review board's approval was not required.

Hands-on neuroendovascular practice

Each group performed hands-on neuroendovascular practice for mechanical thrombectomy during BSL. First, the indications for and methods of thrombectomy were explained, and then a video demonstrating the procedure and typical movement of the catheter was presented. After the demonstration, a simulated thrombus was inserted into an artificial blood vessel model, and thrombectomy using a microcatheter and stent retriever was performed by each student. In addition, thrombectomy using an aspiration catheter only and a combined technique using an aspiration catheter and a stent retriever were also performed by the students, and the overall time for the hands-on practice ranged from 120 min to 150 min, depending on the number of students and the ease of progress.

Questionnaire

After the practice was completed, a questionnaire regarding the students' understanding and their aspirations for specialization in their careers before and after the practice was anonymously collected from the students. The Chi-squared tests were used to investigate differences in the proportions of answers before and after the practice. The level of statistical significance was set at $P < 0.05$. JMP (version 17; SAS Institute, Cary, NC, USA) was used for all statistical analyses.

RESULTS

A total of 153 students, including 51 in the first batch and 102 in the second batch, completed the practice and questionnaire. The reasons for the lower number of responses from the first batch were the inclusion of students who did not practice at our hospital, the presence of groups that could not participate in the hands-on practice due to scheduling conflicts, and a low response rate. Details regarding the questionnaire and the students' responses are presented in Table 1. Through participating in the hands-on practice, the students realized that neurosurgical operations, including craniotomy and endovascular surgery, deepened their understanding of thrombectomy and increased their interest in pursuing neurosurgery as a specialization. The answers to Q3, regarding their aspirations of becoming neurosurgeons, are shown as a bar graph in Figure 1. Through this practice, the number of students in the first and second batches who considered neurosurgery as their first choice or as one of their specialty choices increased from 8 (5.2%) to 12 (7.8%) ($P = 0.3534$) and from 19 (12.4%) to 52 (34.0%) ($P < 0.001$), respectively. Furthermore, the number of students with no aspirations for neurosurgery decreased from 95 (62.1%) to 43 (28.1%) ($P < 0.001$).

Table 1: Questionnaire and responses.

Q1. What do you imagine neurosurgical operations are like?			
	Before practice	After practice	
Craniotomy only	11	0	
Endovascular surgery only	2	0	
Both equally	34	89	
Both, but craniotomy dominance	84	36	
Both, but endovascular surgery dominance	10	27	
No idea	12	1	
Q2. Do you know about mechanical thrombectomy for ischemic stroke?			
I do not know at all	23	1	
I do not know the details	118	31	
I know the details	12	121	
Q3. Do you consider neurosurgery as your specialty in your future career?			P-value
First choice	8	12	0.3534
One of the first choices	19	52	<0.001
Neutral	31	46	0.0476
No aspiration for neurosurgery	95	43	<0.001
Q4. Did participating in hands-on practice increase your interest in neurosurgery?			
Yes/No	140/13		
Q5. Do you think that hands-on practice will increase the chances of students to aspire to become a neurosurgeon?			
Yes/No	116/37		

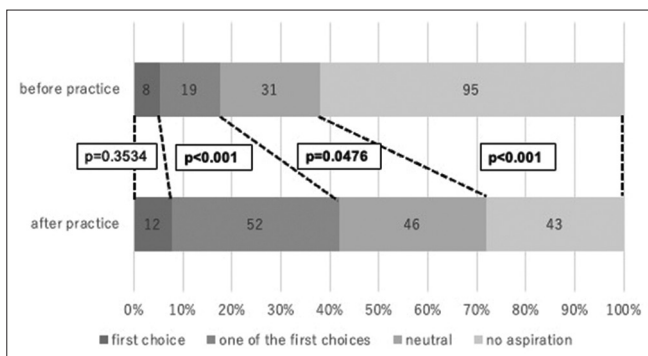


Figure 1: Changes in neurosurgery specialization aspirations before and after hands-on practice. The number of students considering neurosurgery for specialization increased from 19 to 52 ($P < 0.001$), whereas those with no such aspiration decreased from 95 to 43 ($P < 0.001$).

DISCUSSION

In the present study, a hands-on neuroendovascular practice for nonselective medical students, including those not interested in neurosurgery, increased their interest in pursuing neurosurgery, increased the number of students aspiring to become neurosurgeons, and contributed to a mind shift in students with no interest in neurosurgery as a career.

The number of medical students aspiring to become neurosurgeons has decreased worldwide, with one of the

major reasons being the poor work-life balance among neurosurgeons;^[2,3,4,8,12,18] increased stress and burnout among neurosurgeons are additional related concerns.^[9,10,14-16] In such situations, it is essential to introduce students to the positive sides of neurosurgery and actively recruit them to the field. It is important to keep students interested in neurosurgery and target students who are not interested to increase the number of students aspiring to become neurosurgeons. According to previous studies, early exposure of students to cadaver practice, surgery, and hands-on practice modules effectively increases their interest in neurosurgery.^[4-8,11,13,18] Furthermore, most of these exposures were targeted at students who volunteered to participate or were already interested in neurosurgery. While such focused education is effective, Zoli *et al.* suggested that neurosurgical education and training should involve all students.^[17] The present study was also based on the belief that it is important to provide an opportunity for all students to receive exposure to neurosurgery, including those not interested in neurosurgery, and hands-on neuroendovascular practice for nonselective students may be effective for this purpose. The present study targeted 5th-year medical students; however, considering the effectiveness of early exposure, hands-on practice for students in the earlier years of their medical degree program might increase the number of neurosurgery applicants. Agarwal *et al.* reported that organized exposure over multiple phases increased the number of students applying to neurosurgery.^[11] Accordingly, in our study, recruitment to neurosurgery could

be more effective by combining multi-stage exposure and other practices, including direct surgery, rather than one hands-on neuroendovascular practice only.

In the present study, the number of students who wanted to select neurosurgery as one of their specialties significantly increased. Moreover, the number of students with no aspirations to become neurosurgeons significantly decreased after participation in the hands-on practice. However, the number of students who considered neurosurgery as their first-choice specialty did not significantly change. This might be because, although the hands-on practice increased student interest, they remained indecisive about whether this is a better option than other fields.

Interests and aspirations for a particular clinical department depend not only on the interests felt during the practice but also on factors such as job satisfaction, income, lifestyle, and working area. A few more years of follow-up are required to determine whether students will select neurosurgery as a specialization after exposure to the hands-on practice of performing neurosurgical procedures. However, the hands-on practice likely provided an impetus to aspire to become a neurosurgeon. Therefore, medical faculty should actively incorporate hands-on practice into students' education to recruit students who find neurosurgery is interesting.

Study limitations

This study had some limitations, with the most important one being the lack of long-term follow-up. Given the questionnaire was administered right after participation, it is unclear whether a sustained interest in neurosurgery was generated and whether the practice increased the number of students applying for neurosurgery residency. In addition, there is a possibility of recall bias, as the students were questioned after the practice session about their interest in neurosurgery before the practice session. Moreover, if a group that did not receive the hands-on practice was established as a control group, it is possible that the efficacy of the practice could have become clearer. However, based on the principle of educational equity, no control group was established in this study. This study was conducted at a single facility in Japan, and the results may not be generalizable to larger populations in the authors' countries or other countries. Since the environments surrounding medical students and neurosurgeons differ in each country, we believe that it is useful to take measures that correspond to each situation.

CONCLUSION

Hands-on neuroendovascular practice for nonselective medical students increased their interest in neurosurgery and aspirations of becoming neurosurgeons. In the

future investigations into whether these students chose neurosurgery would be helpful.

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Ethical approval

This study did not include patient information; therefore, the institutional review board's approval was not required.

Declaration of patient consent

Patient's consent was not required as there are no patients in this study.

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Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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