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Original Article

Neurosurgical skills conference for medical students: A before and after study

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ABSTRACT

Background: Undergraduate conferences may improve exposure to neurosurgery among medical students. Hence, this study aimed to evaluate the effect of a neurosurgical skills conference on medical students' comprehension and perceptions of the specialty.

Methods: A before-and-after (BA) study design was employed to assess the effects of a conference that integrated presentations with hands-on sessions. Practical workshops covered craniotomy, spinal fixation, surface anatomy, intracranial pressure (ICP) monitoring, basic surgical skills, and microsurgical simulation. Pre-conference and post-conference surveys, utilizing Likert scales, gauged participants' attitudes, prior neurosurgical exposure, and understanding of neurosurgical skills. Statistical analysis was conducted on dichotomized responses.

Results: Thirty-one participants completed both surveys, with the majority being 1st and 2nd-year medical students. Among the participants, 58.1% were female, and 77.4% identified with BAME ethnicities. Following the conference, there was a notable increase in comprehension regarding neurosurgical careers (from 58.1% to 96.8%, $P < 0.001$) and training criteria (from 22.6% to 93.5%, $P < 0.001$). The conference enhanced knowledge of indications for craniotomy ($P < 0.001$), ICP monitoring ($P < 0.001$), and spinal fixation ($P < 0.001$). Participants reported improved understanding of the steps involved in craniotomy ($P < 0.001$), familiarity with basic cranial surgical surface anatomy ($P < 0.001$), and confidence in performing basic surgical instrument ties ($P < 0.001$). Although interest in pursuing a career in neurosurgery remained high (from 87.1% to 90.3%, $P = 1.000$), a majority of participants, both BA the conference, expressed concerns about the impact on personal life (from 58.1% to 64.5%, $P = 0.774$).

Conclusion: This study underscores the role of undergraduate mixed-method conferences in augmenting understanding of neurosurgery and nurturing early interest.

Keywords: Conference, Education, Medical students, Neurosurgical skills, Simulation training

INTRODUCTION

Over the past decade, neurosurgery has consistently maintained its status as one of the most competitive surgical specialties in the United Kingdom (UK). In 2022, despite there being only

16 surgical training 1 (ST1) posts available at a national level, 255 candidates applied to the shortlisting stage, and 56 of them progressed to the interview stage, resulting in a competition ratio of 15.94. In comparison, the competition ratio for core ST1 in 2022 was 3.88.[13]

The National Neurosurgery Selection Board utilizes selection shortlisting scores based on robust criteria that assess undergraduate and postgraduate research, awards, leadership skills, and teaching experience to identify the most promising candidates for interview.[14] Since only 22% of candidates advanced to the interview stage in 2022,[14] the shortlisting phase is pivotal for securing a neurosurgical post. It is worth noting that the shortlisting score also contributes to the final post-interview total score. Therefore, cultivating an interest in neurosurgery early during medical school is crucial, as it provides more time to meet the standards required to secure a place in this highly competitive surgical specialty. Conversely, a lack of exposure to neurosurgery during medical school makes it less likely to be then chosen as a future career.[2]

The current situation highlights the need for increased clinical exposure and comprehensive undergraduate neurosurgical teaching in the UK.[11,16] Early exposure, the presence of active neurosurgery interest groups, research opportunities, and strong mentorship[12] are essential factors that contribute to an early enthusiasm and commitment to the specialty. Several initiatives have been undertaken to engage medical students in neurosurgery. For instance, the Neurology and Neurosurgery Interest Group, affiliated with the Society of British Neurological Surgeons, has conducted national neurosurgical skills workshops for medical students and foundation trainees across the UK.[6] Furthermore, the Glasgow Neuro Society, affiliated with the University of Glasgow Medical School, organized one of the initial national neurosurgical conferences for medical students in Scotland.[1] These workshops aim to cultivate enthusiasm for neurosurgery and provide a platform for practicing basic neurosurgical skills in a controlled environment.

In this context, we report our experiences organizing a society-led undergraduate neurosurgical conference with the support of the regional neurosurgical department. Our objectives were to analyze the impact of our conference on neurosurgical interest, attitude toward the specialty, as well as knowledge of basic neurosurgical skills and indications through surveying participants pre-conference and post-conference.

MATERIALS AND METHODS

Participants were recruited from attendees of the Aberdeen National Neurosurgical Skills Conference 2023, a medical student-led and neurosurgeon-delivered conference held in Aberdeen, Scotland. Attendees consisted of medical students from various medical schools [Table 1]. The conference commenced with trainee and consultant neurosurgeon-led talks in the morning session covering "Life as a Neurosurgeon," "How to Apply for a Neurosurgical Post," and "An Expedition into Microneurosurgical Skills." In the afternoon, four rotating small-group (tutor to participant ratio of 1:5) workshops covered craniotomy, spinal fixation, surface anatomy and intracranial pressure (ICP) monitoring, as well as basic surgical skills and microsurgical simulation. Each neurosurgical skills station was led by at least one neurosurgeon, with student volunteers providing organizational support. The basic surgical skills and microsurgical skills station were led by a core surgical trainee and committee member, respectively. A summary of the conference proceedings is seen in Figure 1.

Afternoon stations

Participants were divided into four small groups. Each group spent 50 min at each of the four workshops before rotating sequentially.

Table 1: Table of study characteristics.

Parameter	Mean (SD)	Count (*n*=31)	%
Age	21 (2.78)		
Gender			
Male		13	41.9
Female		18	58.1
Ethnicity			
Chinese/Asian/British Asian		16	51.6
Middle Eastern		2	6.5
Caucasian British		7	22.6
Other Caucasian		5	16.1
African/Caribbean		1	3.2
Institution			
University of Aberdeen		24	77.4
University of St. Andrews		6	19.4
Charles University		1	3.2
Year of Study			
1		11	35.5
2		12	38.7
3		6	19.4
4		2	6.5
5		0	0.0
Intercalation		0	0.0
Level of entry			
Undergraduate		26	83.9
Graduate		5	16.1

SD: Standard deviation

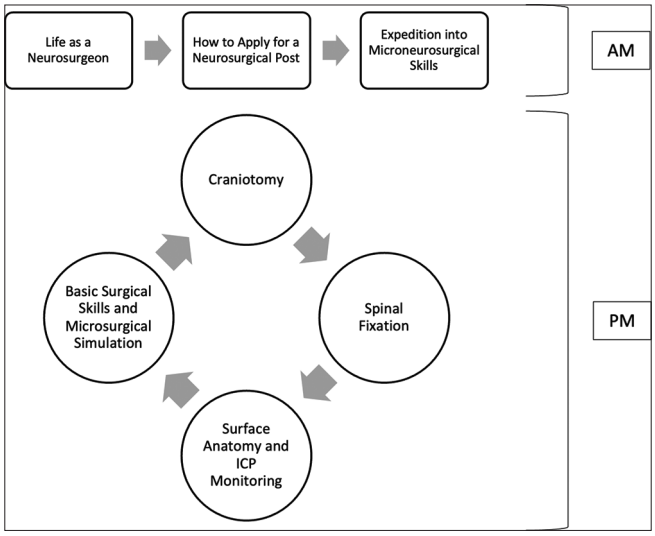

Figure 1: Overview of conference proceedings. The morning session consisted of whole-session lectures. The afternoon consisted of small rotating groups with hands on practical workshops. "AM" and "PM" are used to denote morning and afternoon sessions, respectively.

Figure 2: Set-up for craniotomy simulation. Brown coconuts were fixed using either (a) 3-point (DORO®) skull clamps or (b) Bar clamps. (c) Medtronic® high-speed drills with drill head and craniotome attachments were used, alongside a corresponding foot-pedal.

Station 1: Craniotomy

We utilized a combination of theater standard equipment, including drills, craniotomes, and 3-point (DORO®) skull clamps, alongside bar clamps, G-clamps, and tabletop vises to simulate craniotomy [Figure 2]. In an adaptation of the method described by Drummond-Braga *et al*., in which green coconuts were used for the first steps of a craniotomy,[4] store-bought brown coconuts served as inexpensive cranial simulators. This eco-friendly, more sustainable approach allowed for repeated practice positioning the three-point headrest, as well as using the high-speed drill and craniotome to perform craniotomy. Throughout the session, tutors provided close supervision, ensuring a safe and productive learning environment.

Station 2: Spinal fixation

Participants participated in a hands-on workshop utilizing Medtronic StealthStation® surgical navigation, pedicle screws and connecting rods to perform spinal fixation. The session began with a demonstration and teaching session on the procedure itself, including basic spinal pathology, to provide a foundation for the hands-on component. During the hands-on workshop, delegates were individually guided by a neurosurgeon to use the navigation system.

Station 3: Surface anatomy and ICP monitoring

Participants first receive teaching from a consultant neurosurgeon on pertinent neurosurgical surface anatomy. Next, participants were asked to wear theatre caps and practice drawing relevant cranial surface anatomy on their consenting peers. An option to opt-out was made available to participants. The insertion of subarachnoid ICP monitoring and extra-ventricular drains was then demonstrated using the Rowena™ model.

Station 4: Suturing and microsurgical skills

Hands on basic interrupted, mattress and subcuticular suturing were taught using suturing pads. Microsurgical stimulation was performed based on designs by Gallardo *et al*.,[5] using squared paper, a pen, the participants' phone, and a cardboard enclosure. Students were then challenged to draw a specific pattern using only their phone for visualization [Figure 3].

Data collection

To determine the impact of this conference on our attendees' attitudes, perceptions and knowledge of neurosurgery, pre-conference and post-conference questionnaires were designed using Google Forms. The pre-conference survey was distributed to attendees during the morning introductory session before talks commenced. A post-conference survey was distributed at the end of the session, as well as through email to attendees who had completed the pre-conference questionnaire. In cases where participants submitted multiple form submissions, only their latest submission was considered. The questionnaire utilized paired questions to gauge the conference's impact on interest in neurosurgery and knowledge of neurosurgical skills. Data on demographics, prior exposure to neurosurgery, and conference enjoyment were also collected. The survey

Figure 3: Set-up for microsurgical simulation. Cardboard boxes were used to design the microsurgical simulator pictured above. Participants were asked to place their phones into the cut-out, allowing for their phone cameras to serve as viewfinders. Participants were next asked to shade squared paper in a specific pattern using their phone as a viewfinder.

utilized a mixture of multiple-choice, 5-point Likert-scale, and free-form questions.

Data analysis

Statistical analysis was performed using the Statistical Package for the Social Science version 28.0.1.1. Responses to questions on demography and unpaired questions were summarized using frequencies or summary statistics. In the case of paired questions, responses were first dichotomized by grouping to allow for inferential statistical analysis using *McNemar's test*. Specifically, the responses "Strongly agree" and "Agree" were grouped as "Agree," whereas "Strongly disagree," "Disagree," and "Neutral"/"Neither" were grouped as "Neutral/Disagree." $P < 0.05$ was considered statistically significant.

RESULTS

Of the 33 participants who attended the conference, the study recruited 31 participants. Of these participants, 58.1% were female, and 77.4% were non-Caucasian British. Most participants were 1st and 2nd-year medical students without a prior university degree. Most participants were attendees of Scottish medical schools, with only a single medical student attending a foreign medical school. A summary of the demographics of our participants is shown in Table 1.

Analysis of the paired questions (repeated both in the pre-conference and post-conference questionnaire) showed that the proportion of participants who believe they understand what a career in neurosurgery would involve increased significantly from 58.1% to 96.8% ($P < 0.001$). A significant increase from 22.6% to 93.5% was seen in the proportion of participants who believed they understood the process and criteria for neurosurgical training ($P < 0.001$). There was also a significant increase in the proportion of participants who believed that they understood the indications for a craniotomy ($P < 0.001$), understood the steps behind undertaking a craniotomy ($P < 0.001$), knew the indications behind ICP bolt placement ($P < 0.001$), had awareness of basic cranial surface anatomy ($P < 0.001$), could confidently perform a basic instrument tie ($P < 0.001$), and were aware of the indications behind surgical fixation of the spine ($P < 0.001$). A summary of these findings is seen in Table 2.

Participant interest in neurosurgery as a career was not significantly affected by the conference, with 87.1% of attendees interested in neurosurgery as a career before the conference and 90.3% interested after the event ($P = 1.000$). Moreover, there was no statistically significant difference in intention to complete a neurosurgical elective, with 54.8% before and 74.2% after the conference ($P = 0.700$). A desire for a neurosurgical mentorship scheme was similarly high before and after the conference at 90.3% and 93.5%, respectively, with no significant difference in the proportions ($P = 1.000$). Perceptions regarding the impact of a neurosurgical career on personal life were also not significantly different pre- and post-conference, with 58.1% and 64.5%, respectively, ($P = 0.774$) believing that a career in neurosurgery means compromising personal life. A summary of these findings is seen in Table 2.

Pre-conference specific questions, which sought to elucidate existing pre-conference exposure to neurosurgery, showed that most respondents were either neutral (45.2%) or disagreed (41.9%) when asked if they believed that their medical school had provided sufficient exposure to the field of neurosurgery. Moreover, all respondents strongly agreed or agreed that a resource which compiles useful information on neurosurgical applications would be useful. Table 3 summarizes responses to both these questions.

Post-conference-specific questions showed that 100% of respondents either strongly agreed or agreed that they enjoyed the conference and would recommend it to their peers. About 96.8% of respondents believed that the conference provided good insight into the surgical skills required for neurosurgery. About 100% of participants strongly agreed or agreed that the craniotomy skull clamp fixation and basic surgical skills stations were useful and enjoyable. About 67.7% strongly agreed or agreed that the pedicle screws and S8 navigation station were useful and enjoyable, and 93.5% of participants agreed or strongly agreed the same for the microsurgical skills station. The majority of participants

Table 2: Paired questions comparing interest and understanding of neurosurgery and neurosurgical procedures.

Question	Pre-conference (*n*=31)		Post-conference (*n*=31)		*P*-value
	Agree, *n* (%)	Neutral/ Disagree, *n* (%)	Agree, *n* (%)	Neutral/ Disagree, *n* (%)	
I am interested in pursuing a career in neurosurgery.	27 (87.1)	4 (12.9)	28 (90.3)	3 (9.7)	1.000
I understand what pursuing a career in neurosurgery would involve.	18 (58.1)	13 (41.9)	30 (96.8)	1 (3.2)	<0.001
Choosing a career in Neurosurgery means compromising personal life.	18 (58.1)	13 (41.9)	20 (64.5)	11 (35.5)	0.774
I understand the process and selection criteria for neurosurgical specialty training.	7 (22.6)	24 (77.4)	29 (93.5)	2 (6.5)	<0.001
I have or intend to complete an elective/quality improvement project/research project in neurosurgery.*	17 (54.8)	14 (45.2)	23 (74.2)	8 (25.8)	0.700
A neurosurgical mentorship program would be useful.	28 (90.3)	3 (9.7)	29 (93.5)	2 (6.5)	1.000
I understand the indications behind a craniotomy.	8 (25.8)	23 (74.2)	28 (90.3)	3 (9.7)	<0.001
I understand the steps involved in undertaking a craniotomy.	6 (19.4)	25 (80.6)	27 (87.1)	4 (12.9)	<0.001
I am aware of the basic indications for ICP bolt placement.	3 (9.7)	28 (90.3)	25 (80.6)	6 (19.4)	<0.001
I am aware of the basic cranial surgical surface anatomy.	11 (35.5)	20 (64.5)	28 (90.3)	3 (9.7)	<0.001
I can confidently perform a basic instrument tie.	8 (25.8)	23 (74.2)	30 (96.8)	1 (3.2)	<0.001
I am aware of the indications in which surgical fixation of the spine is utilized within spinal surgery.	6 (19.4)	25 (80.6)	27 (87.1)	4 (12.9)	<0.001

*Phrased differently in the post-conference survey as "I intend to complete an elective/quality improvement project/research project in Neurosurgery."
ICP: Intracranial pressure

Table 3: Pre-conference questions gauging existing exposure to neurosurgery.

Statement	Strongly agree, *n* (%)	Agree, *n* (%)	Neutral, *n* (%)	Disagree, *n* (%)	Strongly disagree, *n* (%)
My medical school has provided sufficient exposure to the field of neurosurgery.	1 (3.2)	3 (9.7)	14 (45.2)	13 (41.9)	–
A resource which compiles all useful information on Neurosurgery applications would be helpful.	26 (83.9)	5 (16.1)	–	–	–

(n = 21) who responded to questions on the presentations given by our speakers found them to be useful and enjoyable (mean participants who strongly agreed: 16.3 ± 1.53, mean participants who agreed: 4 ± 1). The pedicle screw and S8 navigation system and craniotomy and skull clamp fixation stations were rated by participants as the most enjoyable (48.4% and 38.7%, respectively). A summary of the responses to the post-conference specific questions is shown in Table 4.

DISCUSSION

As one of the most competitive surgical specialties in the UK, application to neurosurgery requires consistent engagement with the specialty starting as early as medical school. However, a lack of exposure to neurosurgery among medical students may result in a lack of interest and understanding of the field. Recently, society-lead neurosurgery conferences were shown to offer a more easily accessible platform for medical students to explore their interests. Using pre- and post-event surveys, this study aimed to analyze the impact of our neurosurgery conference on the interest, attitude, and basic knowledge of the specialty among the participants. The results of our study suggest that a mixed-method delivery of neurosurgical skills education, which combined talks and practical workshops, significantly increased students' understanding of the neurosurgical career and skillset. This improvement exists on a background of participant-reported insufficiency in prior medical school exposure to neurosurgery. In addition, we found that a practical approach to neurosurgical education was reported to be useful and well-received by most attendees.

Our findings demonstrated that participants' understanding of what a neurosurgical career involves increased from 58.1% to 96.8% ($P < 0.001$), while their understanding of

Table 4: Post-conference quality and enjoyment metrics.

Statement/Question	Strongly agree, *n* (%)	Agree, *n* (%)	Neutral, *n* (%)	Disagree, *n* (%)	Strongly disagree, *n* (%)
The craniotomy and skull clamp fixation station was useful and enjoyable.	25 (80.6)	6 (19.4)	–	–	–
The pedicle screws and S8 navigation station were useful and enjoyable.	13 (41.9)	8 (25.8)	3 (9.7)	2 (6.5)	5 (16.1)
The basic surgical skills station was useful and enjoyable.	24 (77.4)	7 (22.6)	–	–	–
The microsurgical skills simulation was useful and enjoyable.	17 (54.8)	12 (38.7)	2 (6.5)	–	–
Did you enjoy attending the conference?	27 (87.1)	4 (12.9)	–	–	–
The conference provided good insight into the surgical skills required for Neurosurgery.	26 (83.9)	4 (12.9)	–	1 (3.2)	–
I would recommend attending this conference to my peers.	30 (96.8)	1 (3.2)	–	–	–
The talks were useful and enjoyable* (*n*=21), mean±standard deviation	16.3±1.53 (mean±SD)	4±1 (mean±SD)	0.67±0.58 (mean±SD)	–	–
	Craniotomy and skull clamp fixation		**Pedicle screws and S8 navigation system**		**Basic surgical skills and microsurgery**
Which practical skills station did you enjoy the most?	12 (38.7)		15 (48.4)		4 (12.9)

*This Is an aggregate metric based on the response to three questions regarding each presentation

the selection criteria for neurosurgical specialty training increased from 22.6% to 93.5% ($P < 0.001$) post-conference. Other student-led neurosurgical conferences reported a similarly significant change in understanding levels.[1,2] There was no significant improvement in interest in a career in neurosurgery (87.1–90.3%, $P = 1.000$) or intention to complete a neurosurgical elective (54.8–74.2%, $P = 0.700$). Therefore, it is reasonable to assume that attendees of our conference were already highly motivated toward a career in neurosurgery before attending the conference. Prior studies conducted by Ashraf *et al*. and Hanrahan *et al*. also identified a highly motivated cohort with a pre-existing interest in neurosurgery.[1,7] Interestingly, the study by Ashraf *et al*. also demonstrated that career lectures did not significantly change the proportion of participants who agreed that a career in neurosurgery would implicate personal relationships.[1] This is consistent with our study showing that the majority of our cohort agreed that a neurosurgical career means compromising personal life, with no change in proportions pre- and post-conference (58.1–64.5%, $P = 0.774$).

Our study took a step further and demonstrated that the mixed-delivery method of workshops and lectures resulted in a significant increase in understanding of four neurosurgical skills and the indications for each. Table 2 demonstrated significantly improved understanding (all $P < 0.001$) of the indications of a craniotomy (25.8–90.3%), how to perform a craniotomy (19.4–87.1%), indications of ICP bolt placement (9.7–80.6%), basic cranial surface anatomy (35.5–90.3%), and indications for surgical fixation of the spine (19.4–87.1%). To the best of our knowledge, our study is the first to clearly demonstrate an increase in knowledge of neurosurgery-specific skillsets through hands-on workshops at the undergraduate level. A study by DiPasquale *et al*. highlights the importance of both hands-on surgical skill building and interaction with surgeons on the confidence of students in their surgical ability.[3] Our conference incorporated surgeons into every workshop at a tutor Participant ratio of 1:5, and this might positively contribute to the increased understanding across all four workshops.

As much as 87.1% of participants were either neutral or disagreed when asked whether they believed their medical school had provided sufficient exposure to neurosurgery. Similar statistics have been reported across multiple studies [8,10], with one study showing that 35.1% of the cohort identified a lack of exposure in medical school as their reason for dissuasion toward neurosurgery.[15] Addressing these perceptions has been shown to increase the recruitment of junior doctors to the surgical workforce.[9] It is important to recognize that 74.2% of our cohort was from the 1st and 2nd year of medical school. As such, they may simply have not yet received the relevant teaching and placement opportunities provided during later years. However, this only further highlights how students develop an interest in surgery much earlier than what the curriculum can offer, and conferences like ours provide the means to bridge those gaps.

One limitation of our study is the small sample size (31 participants), with most being 1st year or 2nd-year medical students from the University of Aberdeen. Therefore, this may not be a full representation of the nation-wide medical student population and lead to decreased generalizability. In addition, nearly all participants already had an interest in neurosurgery, potentially introducing bias. Future work may consider adopting a larger sample size and attempting to recruit a cohort with a less pre-existing interest in the specialty. This may, in-part, be achieved through medical school curriculum integration, that is, as part of the neurosurgical clinical teaching block, or by incentivizing less keen students to join by offering career-building opportunities.

CONCLUSION

Society-led neurosurgery conferences can serve to reduce the long-standing lack of exposure to the specialty among medical students. Through a mixed-method delivery of lectures and workshops with a high tutor: participant ratio, we demonstrated an improvement in overall understanding of the specialty and specific skillsets among our participants. Early exposure to both hands-on experience and interaction with surgeons is required for productive engagement with neurosurgery, and other undergraduate-level neurosurgical societies are encouraged to employ similar methods to support their students. Novel approaches to target less initially motivated medical students are needed to elucidate if neurosurgical conferences of this nature have a more widespread pedagogical impact.

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Ethical approval

Institutional Review Board approval was not required as this study represented low ethical risk on assessment.

Declaration of participant consent

The authors certify that they have obtained all appropriate participant consent.

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Nil.

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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