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Transformation of practical exercise in neurosurgery depending on the level of training

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Dear Editor,

Following the publication of our EANS Young Neurosurgeons Committee (YNC) survey on the transformation of neurosurgical training through technologies (Stengel et al., 2022), we would like to share further reflections on modern neurosurgery training – in particular its relation to a trainee's educational stage. The current training situation is difficult, as working hour restrictions limit the access of trainees to the operation room (OR) (Schaller, 2013). Hospitals in return employ more residents and the department's caseload is distributed among a higher number of trainees (Stienen et al., 2016a, 2016b). As private practice competes with academic hospitals for the relatively simple and "ideal teaching procedures", even some of the large and highly recognized centers face difficulties to maintain the required case numbers & ensure high-quality training (Stienen et al., 2020). Hence, a considerable number of trainees feel not sufficiently trained, resulting in anxiety regarding the beginning as board-certified surgeons (Stienen et al., 2016a, 2016b). The present situation calls for a paradigm change in the way neurosurgical training is conducted, which is why our EANS YNC survey intended to critically evaluate the use of "modern" training modalities.

The survey revealed that "conventional" training in the cadaver lab is still most common, whereas "modern" training technologies such as simulators or augmented/virtual reality (AR/VR) based technologies are used much less. Moreover, respondents' ratings of perceived value were highest for training in the OR, followed by cadaver training and simulators scoring lower (Stengel et al., 2022). The results of the survey indicated the necessity of continued OR exposure. Modern training technologies can complement training by repeating a skill manifold and hereby prepare for the work in the OR. They shorten the learning curve and increase the efficiency of integrating a number of acquired skill into a complete surgical procedure. It appears like "conventional" and "modern" training technologies should ideally be used complementary – depending on a trainee's level of training.

Junior residents do not benefit as much from assisting in a complex procedure as do senior residents, who have acquired the necessary theoretical background and can contribute to the procedure by performing level-specific parts. In view of time restrictions and progressively limited "patient resources" for OR training, a transformation of practical exercise in neurosurgery, depending on the trainee's level of training appears reasonable.

As such, in the first years of training (e.g., postgraduate year (PGY) 1–2), training could focus on (AR/VR) simulators to acquire basic skills and understanding of the surgical procedures, besides practicing manual dexterity. The advantage of simulators is the continuous availability and targeted training possibility without any risk of patient harm, while their primary limitation is the relatively high expenditure for purchase. European centers are currently formed, where simulators are clustered and residents from hospitals with less financial resources can train (Moiraghi et al., 2020). Moreover, low-fidelity simulators can often function as affordable alternatives to high-fidelity solutions.

In the next stage of training (PGY 3–4), cadaver lab training ensures integration of the previously acquired skills and efficient completion of surgical procedures. The high subjective rating of the cadaver lab's perceived value for training in our survey supports its importance. With increasing level of experience, the "modern" training technologies become less important, whereas haptic feedback from real anatomical tissue dissections is essential. Since a real OR scenario and sensory feedback of live tissue can only be simulated to a limited extent, continuous training in the OR must accompany the training and progressively increase over the course of residency.

For the last stage of training (PGY 5–6), residents have been prepared to now focus on surgical training in the OR, which helps to ensure that final skill gaps can be closed. These systematically trained senior residents serve as valuable adjuncts to the attending neurosurgeons, which in turn allow them to contribute more actively to large and complex parts of the procedures. Current literature on neurosurgical "hands-on" education in the OR shows that complication rates and outcomes are similar but "teaching procedures" consistently require more OR time (Joswig et al., 2016; Stienen et al., 2015); an effect that may potentially attenuate when residents are more systematically prepared.

Fig. 1 depicts our concept of effective training in modern neurosurgery, considering and depending on the level of training. In the starting years, training with AR/VR and simulators takes up the largest share.

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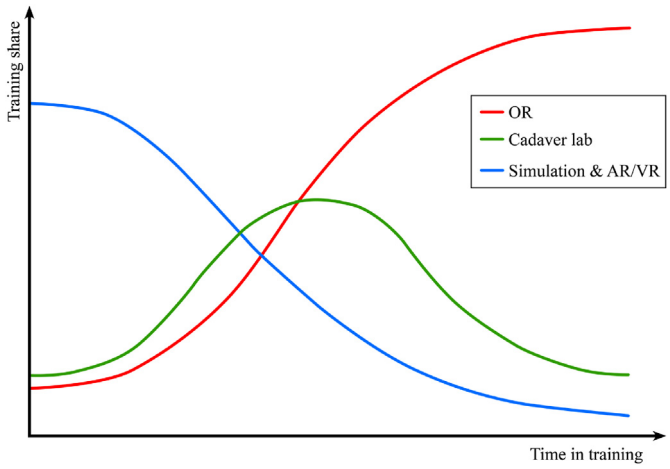

Fig. 1. Concept of modern neurosurgical training depending on the level of training

This share decreases as trainees progress, whereas cadaver-lab training gains importance. A steadily increasing OR exposure is seen in the final years, allowing for a decrease in the proportion of cadaver-lab training. The steepness and length of the curves may be adjusted in relation to internal (individual skills, dexterity) and external factors (number of trainees, caseload of the department, availability of "modern" training technologies, etc.).

We anticipate that the current generation of neurosurgical trainees understands the potential and distinct value of level-specific training methods. We could imagine that a concept similar or equal to ours will find entry into future training policies, such as from the EANS, considering today's suboptimal and non-sustainable training conditions.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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