HOW TO UNDERSTAND IT: STROKE AS A CAREER OPTION FOR NEUROLOGISTS

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Word count: 3701 words, abstract 116 words

Abstract

Stroke is one of the most common acute neurological disorders and a leading cause of disability worldwide. New evidence-based treatments have driven a revolution in the clinical management and design of stroke services over the last two decades. A highly skilled, multidisciplinary workforce that includes neurologists as core members is needed to deliver modern stroke care. In the UK, the dedicated subspecialty training programme for stroke medicine has recently been integrated into the neurology curriculum. All neurologists will be trained to contribute to each aspect of the stroke care pathway. Here, we discuss how training in stroke medicine is evolving for neurologists and the opportunities and challenges around practising stroke medicine in the UK and beyond.

Key words: Stroke medicine, stroke career, stroke training, neurology training, vascular neurology

Introduction

Stroke can be life changing for patients and a major burden on healthcare services. It is the second leading cause of death worldwide[1] and the single largest cause of complex disability in the UK[2]. Eighty-five thousand people are hospitalised with stroke each year in England, Wales and Northern Ireland[3]. Over the last few decades, the diagnosis and treatment of stroke patients has transformed from passive observation on medical wards to proactive management in specialised stroke units enriched by research, teaching and specialist expertise. The quality of care provided for individual stroke patients is subject to rigorous national audit in the UK, with annual publication making it a high priority to National Health Service (NHS) organisations[4]. Centralization into large hyperacute stroke units (HASUs) has

resulted in reduced mortality, reduced length of stay, increased thrombolysis and thrombectomy rates and reduced long-term costs to the NHS[5, 6].

Stroke units and reperfusion therapies have shifted the stroke care and management paradigm, necessitating input from highly skilled personnel[7, 8]. However, the Sentinel Stroke National Audit Programme (SSNAP)[9], has revealed that four in ten hospitals providing stroke care across the UK have at least one unfilled consultant post. This increasing difficulty in recruiting consultants in stroke medicine has occurred in parallel with a decline in stroke subspecialty training opportunities. A 21% fall in the number of sites providing an accredited training programme in stroke medicine from 2016 to 2019 has been reported[9]. This was partly because no single parent specialty embraced stroke in the UK. Indeed, the World Stroke Organization expert survey revealed that stroke cases were less often treated by neurologists in the UK and Ireland compared to the other countries[10]. In contrast to the US and most European countries where stroke physicians are neurologists, most stroke physicians have an internal medicine or geriatrics background in the UK and New Zealand, or a neurosurgery background in Japan and Mexico[10]. In the UK, the Shape of Training review was a catalyst for reform of postgraduate training of all doctors[11]. This led to the re-design of training in general internal medicine (GIM) and medical specialties (including neurology). It is now mandatory that, on completion of training, all UK neurologists must be capable of practising independently in neurology, stroke and GIM (including being able to supervise the acute unselected medical intake). The aim is to train neurologists to be capable of participating in the care of stroke patients across the whole care pathway. With the focus on proactive management of ‘front door’ presentations, future consultant neurologists are likely to contribute either to the general medical on-call rota or acute neurology and stroke.

Stroke as a subspecialty in the UK and other countries

Stroke medicine as a subspecialty in the UK was first suggested in 1997[12] and became fully established in 2004[13]. The British Association of Stroke Physicians (BASP) – now the British and Irish Association of Stroke Physicians (BIASP) - proposed integrating stroke training with the Neurology and Geriatrics curricula in 2007[14]. In the United States (US), stroke was established as a subspecialty in 2003[15]. In Europe, the rapid enlargement of neurology resulted in the formation of acute neurology as a subspecialty. Acute neurologists managed the treatment of stroke patients and were closely aligned with the development of neurological emergency medicine[16, 17].

The duration of neurology training and links to associated disciplines (e.g. neurophysiology, psychiatry) also varies worldwide. For example, neurology training is four years in the US and five years in Canada and some European countries but may take much longer in UK when research or training less than full time are factored in. A European Academy of Neurology survey revealed that attachment to a stroke unit was a mandatory part of neurology training in only 17/32 countries (53%); the duration varied from 1–12 months[18].

Certification of ‘vascular neurologists’ has encouraged the development of fellowship programmes worldwide. In the UK, the Federation of Royal Colleges of Physicians recognised national stroke sub-specialty training fellowships[19]. In neurology, these comprised a year of dedicated training in stroke, usually in a major specialist centre. The close alignment of stroke and neurology capabilities meant that trainees could complete the year at the same time as gaining sufficient neurology experience so there was no prolongation of neurology training (Figure 1). The convergence of neurology and stroke in the UK has continued in the new neurology curriculum, launched in 2022, which has incorporated the three stroke curriculum areas: managing acute stroke, preventative care and rehabilitation[20]. This means all future neurologists will have the competencies to lead or contribute to stroke care across the whole care pathway.

The stroke care pathway

Time after stroke can be divided into phases of care: for example, the Stroke Roundtable Consortium designated the first 24 h as the hyperacute phase, the first 7 days as the acute phase, the first 3 months as the early sub-acute phase, months 4–6 as the late sub-acute phase, and from 6 months on as the chronic phase[21]. The rationale behind this differentiation is that the urgency of interventions and recovery processes following stroke are often time dependent. While some patients require an emergency treatment where minutes matter (e.g. revascularisation therapies for hyper-acute ischaemic stroke), others may require holistic end-of-life care or more sustained support towards long-term goals. The most rapid functional improvements frequently occur in the first few weeks and months post-stroke[22, 23]. After six months, recovery may be slower, but with intensive rehabilitation, task-specific training, or other interventions, important improvements can be achieved in the chronic phase, for example in upper limb function[24] or cognitive domains like language[25].

In the hyperacute phase, intravenous thrombolysis (IVT) and endovascular thrombectomy (EVT) have dramatically changed management in stroke. Thrombolysis using recombinant tissue plasminogen activator within 3 to 4.5 hours of stroke symptom onset significantly improved outcomes in acute ischemic stroke[26-28]. Increasing availability of specialist imaging (such as perfusion CT) has extended the treatment window to nine hours[29, 30]. EVT is also now an essential and hugely effective part of modern stroke care. Since 2015, EVT has emerged as a potent treatment yielding a number needed to treat as low as 2.6 for people to be independent by 3 months after stroke[31-33]. Those trials confirmed the benefit of EVT over IVT alone among patients suffering acute ischaemic stroke with large intracranial vessel occlusion. In 2018, the treatment window for EVT was extended from 6 hours to 24 hours in selected patients[34, 35]. These advances have provided the opportunity to treat more people

with revascularisation therapy but also increased the specialist resources needed to assess stroke patients rapidly.

Neurology trainees can make important contributions to this entire stroke patient journey, allowing them to acquire a broad range of transferable skills. The rapidity of assessment followed by urgent brain imaging to confirm or refute the clinical diagnosis allows prompt feedback on diagnostic skills and can be highly satisfying and hard to match in any other branch of neurology. Patients with stroke present with a huge variety of clinical syndromes from unilateral weakness or speech disorder to a constellation of neurological symptoms and signs that may be challenging to interpret and may reflect multiple lesions or complex brainstem syndromes. Patients also present across the age spectrum; about a quarter are less than 65 years old. Trainees must hone clinical skills to allow rapid assessment and localisation of single or multiple acute lesions. Furthermore, neurology centres now have an array of advanced imaging available, providing unique opportunities for neurologists to sharpen their neuroradiology skills and combine these with clinical assessment to rapidly institute appropriate treatment. Neurologists bring particular expertise to managing stroke patients[36] when diagnosing mimics and fine tuning classification. The on-call stroke team pick up a lot of the acute serious neurology presenting to hospital. The American Academy of Neurology proposed that at least one neurologist should play a key role in the development and/or designation of primary stroke centres[37]. Acute stroke care in hospitals with neurology stroke training programmes has been associated with increased thrombolysis uptake[38, 39]. Young adults with ischaemic stroke who present to hospitals with neurology trainees benefit from a lower missed diagnosis rate[40]. These findings indicate that neurology trainees can make a substantial and important contribution to hyperacute stroke care.

About half of stroke admissions are non-stroke cases or mimic transient ischaemic attacks (TIAs) or stroke; over half of those have a neurological cause[41]. For those who love

diagnostic puzzles, this can be a rewarding area. While many neurology ward admissions will usually have been evaluated by a consultant, the stroke trainee is often the first point of specialist contact and the entire patient outcome may hinge on their clinical acumen.

In the UK, neuroradiologists play the primary interventional role in EVT, but neurologists will have an opportunity to learn this skill and also contribute to the intervention. In 2017, there were only 90 trained neurointerventionalists working in 28 neuroscience centres in the UK[42]. There is increasing demand to diversify the neurointerventionlist demographics[43]. In 17 of 31 European countries, neurovascular stroke procedures are also performed by non-radiologists mainly neurosurgeons or cardiologists[44, 45]. There is a growing interest among neurology trainees across Europe to train in performing EVT[46] and the Royal College of Radiologists with the GMC are pioneering a credential for EVT[47]. This would allow neurologists (amongst others) who have an aptitude for performing practical procedures to train and acquire sufficient neuro-intervention skills to be able to perform angiography and EVT[48 49-51].

Managing patients on the HASU also presents a unique opportunity to combine neurology with general medicine affecting multiple systems. Stroke does not usually happen in isolation. One must often manage hypertension when cerebral autoregulation is failing without causing cerebral hypo- or hyper-perfusion complications. There is neglected diabetes to optimise and cardiac co-morbidities to identify and manage. Stroke patients often develop complications such as infection, pain, delirium, falls and recurrent stroke[52]. Blood biochemistry or liver function may be abnormal and not infrequently there are additional diagnoses to uncover such as malignancy[53, 54]. In the new curriculum, work on a HASU contributes to training in general medicine because one has to be good at managing complicated, overlapping, multi-organ disease. Moreover, the reduced mortality of stroke has

inevitably increased the number of stroke survivors with neurological complications (e.g. seizures, cognitive impairment) that require neurology expertise.

Stroke medicine provides trainees with uniquely rich opportunities to interact with other medical, nursing and allied healthcare professional teams. On the medical side, neurology trainees have opportunities to work with emergency medicine, acute medicine, radiology (including diagnostic and interventional neuroradiology), vascular surgery, neurosurgery and cardiology. Within the ward, collaboration with the stroke multidisciplinary team: nursing colleagues, advanced practitioners, physician associates, physiotherapy, occupational therapy, speech and language therapy, dietetics, psychology, social workers, chaplaincy, palliative care, and the prescribing pharmacist is essential. These interactions provide unrivalled opportunities to develop communication, teamwork, and leadership skills. While acute stroke care can be busy, the wider stroke team engenders great camaraderie which makes practising high-quality stroke medicine fun as well as fulfilling.

The stroke pathway is potentially long, leading to many opportunities for learning and practice beyond the hyperacute phase. Later in the pathway, trainees can be involved in rehabilitation and re-enablement. These are likely to be growth areas in the future with active research programmes. Neurology trainees have the opportunity to learn specialist and complex rehabilitation interventions such as physical, occupational and language therapy as well as novel multimodal approaches including mirror or music-based therapy which can enhance functional recovery[55, 56]. Spasticity management is a big part of stroke rehabilitation and neurology trainees can learn botulinum toxin injections and other evolving non-invasive brain stimulation techniques used to modulate neural plasticity[57-59].

Managing outpatients and ambulatory care

The outpatient clinic is the cornerstone of traditional UK neurology practice and there are many and varied clinics under the umbrella of cerebrovascular disease. The TIA clinic often functions as a neurology hot clinic. Other clinics include routine stroke referral clinics and follow-up from HASU. However, as cerebrovascular disease is so common and diverse, there are many opportunities for super-specialisation and research. Therefore, clinics may specialise in intracerebral haemorrhage, cerebral amyloid angiopathy, vasculitis or genetic causes of stroke. Regular multidisciplinary advice in an ambulatory-care setting is necessary for carotid intervention, the management of aneurysms and other vascular malformations, and for patent foramen ovale closure.

The COVID-19 pandemic ushered in a new era of remote consultations[60]. Pre-pandemic training for remote management of neurologic conditions utilising telemedicine systems was scarce outside a few neurovascular fellowship programmes[61, 62]. Now, standardised tele-stroke management has been associated with increased IVT administration and significantly shorter door-to-needle times without increased adverse outcomes[63]. Digital technology allows stroke specialists to access scans and images remotely and securely meaning they can do their job efficiently whilst supporting other hospitals to deliver high-class stroke care. Mobile stroke unit studies have demonstrated both feasibility and a reduction in time to treatment[64]. The use of tele-medicine consultations, including video-triage[65], will rise both for pre-triage of people coming to hospital, as well as providing ‘out-patient’ consultations more conveniently for patients.

Teaching

There are always opportunities to contribute to undergraduate and postgraduate education in stroke. Cerebrovascular disease is a core component of the foundation and core medical

training curriculum so there are always opportunities to supervise, mentor and encourage junior doctors. Neurology trainees can support education for the multidisciplinary team including advanced practice providers and nurses. Developing excellent communication and teaching skills is vital because engaging teachers are essential in attracting new people to stroke.

The culture of stroke is that all care should be evidence-based and standards maintained through audit. It is entirely acceptable and encouraged for trainees to give a consultant a hard time asking them to justify their decisions on the available evidence as part of an interactive ward round.

Stroke research

Neurology trainees interested in consolidating their interest in stroke research have the opportunity to join stroke research fellowship programmes at any stage of their training offered by stroke academic centres across the UK and beyond. There is also a strong tradition of visiting observerships or research fellowships in stroke specialist centres. Large UK funders support overseas placements which offer unique perspectives and forge new collaborations. For example, The British Heart Foundation provides funds for the directly incurred costs of research projects for six months overseas[66]. The NIHR has also developed an Associate Principal Investigator scheme providing a great way into clinical trial research for trainees[67]. With the new curriculum, neurology trainees will be supported strongly if they wish to take time out to pursue research. Learning outcomes are based on the acquisition of capabilities and as much stroke research is usually clinically oriented, it may be possible to gain credit for a substantial amount of clinical work (neurological and medical) undertaken in

a research programme, potentially shortening training when registrars return to their parent programmes.

Potential research areas include basic biology such as using neuroprotective agents modulating inflammation in hyperacute stroke with a number of trials on-going[68] -e.g. interleukin-1 receptor antagonists[69]. Radiology is continually advancing e.g. with imaging of collateral blood supply identifying those where delayed salvage of the penumbra is feasible[70]. Artificial Intelligence (AI) technology is set to make a huge contribution through collation of clinical data in person[71], remotely[72] or via telemedicine[73]. AI algorithms may identify people at risk of depression[74]. Robotic devices can analyse patient movement patterns to inform therapy[74]. Assistive rehabilitation technology such as vagal nerve stimulation paired with rehabilitation demonstrated clinically meaningful improvements in motor function after ischaemic stroke[75]. Similarly, the brain-computer interface is a novel rehabilitation tool which has been shown to be effective in promoting long-lasting functional improvements in the upper extremity in stroke survivors with severe, moderate and mild impairment[76]. Trials assessing transcranial direct current stimulation in patients with subacute ischemic stroke and residual upper-extremity paresis[77] are in the pipeline. With wireless technology and AI, it should be possible to devise ways of monitoring home blood pressure or glucose and automatically varying medication. Home monitoring technology for patient safety will be a growth area to allow people to remain independent in their own homes for longer.

What are the main challenges of working in stroke medicine?

In stroke medicine, as in other medical specialties, we are aware that there is a real risk of burnout, a syndrome characterised by emotional exhaustion and depersonalization, leading to decreased effectiveness at work[78]. Neurology is among the specialties with the highest

reported burnout syndrome rates[79]. 45% of the neurologists fulfil the criteria for severe burnout syndrome, and over 50% were stroke neurologists in one study[80]. It can lead to maladaptive coping practices such as self-distraction, self-blame, substance use that may damage relationships with both patients and colleagues, thereby risking patient care in the long term[81, 82]. Long working hours and night shift-induced insomnia have been associated with increased emotional exhaustion and risk of clinical burnout[83, 84]. In 2017, the British Medical Association declared that the mental ill-health of NHS staff is a major healthcare issue, leading to absenteeism, presenteeism (the practice of going to work despite illness or anxiety, which often results in reduced productivity) and loss of staff from the workforce[85]. Reduction of the mean working hours to about 7.5 hours per day in medical training has been associated in a reduction in burnout during training from 74% to 56%[86] and a reduction in medical errors by >50%[87]. Healthcare systems rely on physicians who are not yet specialists or consultants to deliver large amounts of emergency, urgent or repetitive service, especially out of hours. Trainees have a major role in out-of-hours service and are susceptible to poor supervision and limited access to learning[88]. In major neurology centres, stroke teams are large with the consultant workforce being much more hands-on for service delivery. With appropriate and graded consultant (specialist) supervision, adequate training can be provided and achieved in spite of the service load[89]. The stroke community is very conscious of burnout. There is a lot of effort to make rotas less onerous and run larger teams to foster camaraderie and ensure peer support.

Attractions of Stroke Medicine for Neurologists

As a group, the authors thought about the things that attracted us to stroke medicine (Table1).

Table 1: Pros and cons of stroke

Pros	*Cons*
Varied and flexible workload - emergency department, ward work, clinics (TIA/stroke) with experience in acute stroke care, rehabilitation, prevention.	Can be busy (depending on staffing levels)
Work as part of a multi-disciplinary team	Lots of national targets and continuous local and national auditing
Plenty of opportunities for research	
Exciting and rapidly developing speciality with new developments in investigations and treatment e.g., Thrombolysis and neuroradiological interventions	
Can be fulfilling - seeing improvement in patients' symptoms	
Part of patient journey over time	

The greatest attraction was that no two days are the same. The combination of emergency, in-patient and outpatient work was varied. We liked being the first neurological contact with cases as well as having the opportunity of seeing people though their whole journey. Watching people recover in front of you with thrombolysis or thrombectomy is tremendously satisfying. We liked participating in research and particularly the rapid and constant developments that entered clinical practice soon after publication. Continuous auditing can appear daunting. However, it provides a brilliant way of driving improvement and monitoring progress of a multi-disciplinary team.

On the contrary, sometimes the workload can feel overwhelming but usually there are enough team members around to help when it is busy. Stroke medicine exemplifies teamwork within a skilled multidisciplinary team which is extremely satisfying. While we liked the audit ethos of stroke, occasionally the feeling that you were being watched by someone with a clipboard and stopwatch grated.

Life as a consultant contributing to stroke care

First let us tackle the potential impact of out-of-hours work and the associated risk of burnout on consultants delivering stroke care. Neurologists will be triple-accredited in neurology, stroke and general medicine after completing their training. It is likely that future neurology consultants will be expected to cover neurology on-calls, stroke on-calls, the general medical take or a combination of these, all of which can be busy. However, in many neuroscience centres, service leaders are very aware of the risk of burnout, so the stroke take is organised to support all consultants. For example, in one of our centres, if stroke consultants are on the rota to cover the night, they are relieved of clinical duties the following day. Weekend days and nights are split. No consultant works 24 hours at a stretch anymore. Similar policies can be applied to daytime work. For example, in one of our centres, two consultants work in tandem on the HASU while another is attached to the emergency department and a fourth manages the long-stay stroke unit. There are always enough hands available to cope when it is busy and no one should be overwhelmed[90]. There are very few services in neurology that have evolved so much to look after their consultant staff.

As the team is large, there are opportunities for consultants who want to work less than full-time. Again, stroke departments aim to write job plans that contribute to the service but also allow a consultant to flourish. From our UK experience, and from feedback from colleagues in Europe and North America, significant variation in job plans exists, suggesting various combinations of clinical, academic and managerial interests can be accommodated to suit the individual. People can agree on a satisfying job with a balance of acute work and clinics when working less than full time. Contributing to a large team with a collaborative ethos means that there is some flexibility within the working week. For example, it is easier to find cover to attend an important meeting or to deal with a domestic emergency.

Stroke medicine for the neurologist provides a challenging and rewarding career with constant clinical variety and academic stimulation. It is an intellectually demanding but fascinating specialty which requires a breadth of clinical intuition and excellent communication skills. There are opportunities for leadership roles in quality improvement programmes, clinical and research initiatives, professional and public educational programmes, and advocacy contributions to public and governmental bodies[43, 91-95]. The acute stroke team requires competent and confident neurologists to be core members of the team.

Conclusions

Recent changes to the neurology higher specialist training curriculum aim to produce consultants who are capable of managing all medical conditions as well as their specialty. Stroke medicine is now an integral part of neurology training in the UK and will likely feature as part the job plan for many UK neurologists, either as part of the day team, in clinic or on call. Stroke is often thought of as a busy specialty and while that is true, the stroke community have taken ownership of that problem and set up teams that deliver first rate, evidence-based care and aim to look after every member of the team so they can thrive in their careers.

KEY POINTS

- Recent changes to the UK neurology higher specialist training curriculum aim to produce consultants who are capable of managing all medical conditions as well as their specialty.
- A highly skilled, multidisciplinary workforce that includes neurologists as core members is needed to deliver modern stroke care.

- The UK stroke community is very conscious of burnout, and have taken ownership of that problem and set up teams that deliver first rate, evidence-based care and aim to look after every member of the team so they can thrive in their careers.

Funding: none

Contribution: ACP and DJW conceived the study. VA, TJM, GC, and SS contributed to literature review and data acquisition**.** VA drafted the initial and ACP drafted final manuscript. All remaining authors critically revised the manuscript. All authors gave final approval for publication.

Conflict of interest: none

Further reading:

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Abbreviations:

AI	Artificial Intelligence
BIASP	British and Irish Association of Stroke Physicians
BASP	British Association of Stroke Physicians
EVT	Endovascular thrombectomy
GIM	General internal medicine

HASU	Hyperacute stroke units
IVT	Intravenous thrombolysis
NHS	National Health Service
SSNAP	Sentinel Stroke National Audit Programme
TIA	Transient ischaemic attacks

LEGENDS

Table 1: Pros and cons of stroke career

Figures 1: Vascular neurology career pathway

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