The Royal College of Surgeons of England

NEUROSURGERY

Ann R Coll Surg Engl 2008; **90**: 508–512
doi 10.1308/003588408X321530

Evolution in practice: how has British neurosurgery changed in the last 10 years?

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ABSTRACT

INTRODUCTION Neurosurgery is a fast-evolving surgical subspecialty driven by technological advances, socio-economic factors and patient expectations. In this study, we have compared the work-load volume in a single institution in the years of 1994 and 2004 and commented on the possible reasons for the changes and the impacts they may have for the future.

PATIENTS AND METHODS A retrospective, log-book review of all operations performed in the years 1994 and 2004 in a single, tertiary, neurosurgical centre was performed.

RESULTS Neurosurgical practice has evolved over this period. Current practice has moved away from clipping of aneurysms and towards coil embolisation performed by interventional radiologists. Electrode stimulation of deep brain regions for movement disorders is the current practice, whereas 10 years ago the same disorders were dealt with by lesioning of the relevant regions. In spinal neurosurgery, instrumentation is increasingly favoured currently. In the field of neuro-oncology, current practice favours minimal access to the target area by the use of stereotactic localisation.

CONCLUSIONS Changes were most pronounced in the subspecialties of vascular, functional and spinal neurosurgery within this 10-year period. Knowledge of such dynamics is valuable in health resource management as well as planning for neurosurgical training programmes.

KEYWORDS

Neurosurgery – Audit – Practice

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Although neurosurgery may be one of the younger surgical specialties,[1] having Sir Victor Horsley among its most celebrated fathers, it may also be one of the most rapidly changing. There are several reasons that drive this evolution, including technological advances, socio-economic factors and expectations of patients.

On the turn of last century, Sir William Osler called for the development of a 'medico-chirurgical neurologist', a polymath trained in the anatomical, physiological, clinical and surgical aspects of the subject.[2] This model though does not apply today with the evolution of surgical neurology and the blossoming of different subspecialties to deal with the vast medical knowledge and medicolegal/risk-management requirements. Today, the Society of British Neurological Surgeons (SBNS) defines the specialty of neurosurgery as that of 'the clinical management of patients with potentially surgical remediable conditions of the central (intracranial and spinal) and peripheral nervous system' with the qualified specialist having to subspecialise further in order to meet the increasing demands made by patients and peers.

The purpose of this study was to investigate the changes in the general practice as well as subspecialty practice within a major neurosurgical unit assessed 10 years apart.

Patients and Methods

All operations performed at the National Hospital for Neurology and Neurosurgery in the years 1994 and 2004 were included by obtaining data from computerised databases and by examination of the theatre log-books. The operations were grouped into sub-types including whether they were performed as emergency or elective. The main subspecialty categories were: functional neurosurgery, spinal surgery, vascular surgery, and neuro-oncology. We did not include any paediatric cases since, in our institution,

Table 1 Summary and breakdown of operative procedures by subspecialty in 1994 and 2004

Title of operation	Operations in 1994	(% of total)	Operations in 2004	(% of total)	Relative % change
Trauma surgery					
Total trauma surgery	143	(0.069)	148	(0.066)	–4
Evacuation of acute subdural haematoma	19	(0.9)	30	(1.34)	49
Evacuation of acute extradural haematoma	25	(1.2)	13	(0.6)	–50
Insertion of ICP monitors	11	(0.5)	36	(1.6)	220
Vascular neurosurgery					
Evacuation of intracerebral haematoma	36	(1.7)	36	(1.6)	–5.8
Carotid endarterectomy	0	(0)	7	(0.3)	
Clipping of aneurysm	75	(3.6)	47	(2.1)	–41.6
Embolisation of vascular lesion	9	(0.4)	58	(2.6)	550
Resection of arteriovenous malformation	10	(0.5)	1	(0.04)	–92
Spinal neurosurgery					
Total spinal operations	394	19.08	308	13.79	–26.7
Spinal operation with instrumentation	97	(4.7)	135	(6)	27.6
Spinal operation without instrumentation	297	(14.4)	173	(7.75)	–46.2
Subcategories					
(I) Excision of spinal tumours	16	(0.77)	24	(1.07)	39
(IIa) Anterior approach to spinal pathology	175	(8.5)	74	(3.3)	–61
(IIb) Posterior approach to spinal pathology	225	(10.9)	236	(10.6)	–2.7
(IIIa) Fixation of cervical pathology	245	(11.9)	180	(8.1)	–32
(IIIb) Fixation of lumbar pathology	119	(5.8)	113	(5.1)	–12
Functional neurosurgery					
Functional lesions	59	(2.85)	0	(0)	–100
Deep brain stimulation	0	(0)	18	(0.8)	
Neuromodulation for chronic pain	23	(1.1)	80	(3.6)	227
Occipital nerve stimulators	0	(0)	11	(0.5)	
Neuro-oncology					
Craniotomy for tumour debulking	245	(11.8)	256	(11.5)	–2.5
Free-hand diagnostic biopsy for cranial tumour	40	(1.9)	11	(0.5)	–73
Frameless stereotactic biopsy of cranial tumour	0	(0)	7	(0.3)	
Stereotactic biopsy of cranial tumour with frame	12	(0.6)	48	(2.15)	258
Transphenoidal hypophysectomy	124	(6)	144	(6.45)	7.5
Hydrocephalus					
Shunting for hydrocephalus	106	(5.1)	130	(5.8)	13.7
External ventriculostomy	46	(2.2)	131	(5.9)	168
Endoscopic third ventriculostomy	0	(0)	4	(0.18)	
Miscellaneous					
Surgery for epilepsy	8	(0.4)	38	(1.7)	325
Cranioplasty	7	(0.35)	35	(1.6)	357
Microvascular decompression	5	(0.24)	16	(0.71)	195
Others/minors	29	(0.01)	140	(0.06)	
Total operations		2064		2232	

we only treat adult patients. In the section examining procedures for functional neurosurgery, we also included those of spinal cord (SCS, hereafter called neuromodulation for chronic pain) and occipital nerve stimulation (ONS). In the vascular field, we were particularly interested to see the impact of the emerging neuroradiological interventional procedures on the service. Since there were no facilities for endovascular coiling in 1994, we recorded the number of coiling embolisation procedures from 1996 when the service was first introduced in our unit. We also examined other subcategories such as operations for hydrocephalus (insertion of an external drainage catheter or a permanent ventriculo-peritoneal catheter, and endoscopic ventriculostomy), as well as surgery for epilepsy. The category labelled 'minors/others' includes cases such as tracheostomies or muscle and nerve biopsies which were pooled together. All percentages mentioned represent relative percentage change unless stated otherwise. The results are summarised in Table 1.

Results

There were 2064 and 2232 operations recorded in the years 1994 and 2004, respectively. This represented an increase of 8% in the case volume load. The percentage of emergency operations in each year was 10% and 18% in 1994 and 2004, respectively. The mean age of patients in 1994 was 49 years (range, 19–88 years) versus 51 years in 2004 (range, 18–91 years).

Vascular neurosurgery

The total number of procedures performed for patients with vascular disease increased by 14.6% (from 130 to 149 in total). However, the number of operations for vascular pathologies fell by 43.5% in the 10-year period. This was mainly due to the development of the interventional radiology services. The number of surgical procedures performed for aneurysms and arteriovenous malformations fell from 85 to 48. In contrast, endovascular coiling procedures increased from 9 in 1996 (there was no facility for coiling in 1994) to 59 in 2004. There was no change in the number of evacuations for intracerebral haematomas (36 in both years). During this period, we have also introduced a service offering carotid endarterectomies to patients with stenotic carotid disease, the numbers increasing from none in 1994 to 7 in 2004.

Functional neurosurgery

Regarding the field of functional neurosurgery for movement disorders, there were a total of 59 stereotactic lesioning procedures performed in 1994. No deep brain stimulators were recorded in this year. In 2004, no lesions were recorded but, instead, 18 deep brain stimulators were implanted. There was also a rise in operations for intractable pain from 23 to 91. This included the implantation of spinal cord stimulators and occipital nerve stimulators; in particular, there were 11 occipital nerve stimulators inserted in 2004 versus none in 1994.

Spinal neurosurgery

The total number of spinal operations fell by 26.7% (394 versus 308). Spinal instrumentation increased by 27.6% (97 versus 135). The total number of operations for spinal tumours increased from 16 to 24 (4.1% to 7.8% of total spinal operations) over this period. There was a shift in the approach to the spine favouring the posterior approach when compared with the anterior approach (225 to 236 and 175 to 74 operations in 1994 and 2004, respectively). This was partly because of increasing use of cervical foraminotomy, in place of anterior cervical discectomy, to treat cervical radiculopathy. There was also a change in the operative site with operations on the lumbar spine increasing from 30.3% in 1994 to 36.7% of the total spinal operations in 2004. The respective operations on the cervical area decreased from 62.2% to 58.4% of the total spinal operations.

Neuro-oncology

The total number of craniotomies for tumour debulking (245 versus 256) and tumour biopsies (52 versus 66) was almost unchanged. There was, however, a clear shift in favour of operative image guidance for localisation of tumours during this period (12 in 1994 and 55 in 2004). There was a small increase in transphenoidal excision of pituitary adenomas (124 versus 144, representing an increase of 7.5%).

Trauma

Total numbers of trauma operations were almost the same in both years (143 versus 148). Craniotomy for the evacuation of an acute subdural haematoma increased by 49%, whereas those for extradural haematoma fell by 50%.

Other procedures

There was little change in the number of shunt operations performed for relief of hydrocephalus (106 versus 130 representing 5.1% versus 5.8% of total operations). There were four third- ventriculostomies in 2004 compared to none in 1994. There was a large increase in the number of external ventriculostomies in the same period (from 46 to 131). Surgery for epilepsy has also been on the increase (from 8 to 38). Microvascular decompression of the Vth and VIIth cranial nerves, an operative solution for trigeminal neuralgia and hemifacial spasm, as well as cranioplasties for post-traumatic or postoperative cranial vault defects have also been on the increase in this 10-year period (from 5 to 16 and from 7 to 35, in 1994 and 2004, respectively).

Discussion

There have been major changes in the practice of neurosurgery in the last decade.[3] Subsequent advances in microsurgical techniques, non-invasive imaging, neuro-anaesthesia, intensive care, image-guided surgery, and the introduction of sophisticated radio-oncological and interventional radiology treatments have changed and widened the scope of neurosurgical practice. The most striking changes are in three subgroups – functional neurosurgery, vascular and spinal surgery.

Within the limitations of a retrospective study reliant on the accuracy and completeness of recorded data, our study indicates generic and specific changes in neurosurgical practice. The work-load increased modestly during this period which was in keeping with the population rise in our catchment area of 8% according to the National Statistics Office figures.[4] It is, however, of note that there were four whole-time equivalent neurosurgical consultants in our department in 1994 versus 8 in 2004, thus almost halving the 'operation per consultant' numbers. The 8% increase in emergency operations might reflect the raised awareness of certain neurosurgical conditions among the primary care physicians (*e.g.* cauda equina compression syndrome[5,6]) and the establishment of guidelines resulting in a lower-threshold for neuroscanning and referring appropriate cases out-of-hours.[7,8] The mean age of the treated population has increased by a mean of 2 years in the last decade. We can be certain that this reflects our change in philosophy of treating increasingly older age groups,[9,10] as well as the impact of the national demographics and the resulting demand on services. In a similar comparative study of 13 years' apart, Barker and colleagues[11] noted a 50% relative case-load increase for adult cases of non-traumatic craniotomy showing a similar trend in treating an older age group in the US.

Vascular, functional and spinal surgery have undergone major advances in this decade. Vascular clipping of aneurysm or surgical treatment of arteriovenous malformations has dramatically decreased as a result of endovascular intervention and the introduction of radiosurgery using focused radiation. The impact that the ISAT trial, an international study to compare the outcome of surgical versus endovascular treatment of aneurysms,[12] has had on patient's choice of treatment and long-term efficacy and mortality, is demonstrated clearly in our figures and we believe that they reflect national figures. Indeed, similar figures have been published elsewhere.[13] This will have major implications for funding of neuroradiology services and training of future neurosurgeons in the treatment of intracranial vascular pathology. In the US, these changes have already resulted in restructuring of neurosurgical training programmes in order for a physician to obtain the status of an endovascular surgical neuroradiologist.[14] So far, these training requirements have been slow to replicate in the UK.

Functional neurosurgery has changed in numbers and nature. Total number of brain lesions has decreased whereas implantation of neurostimulators has dramatically increased. This is fuelled by: (i) improved imaging; (ii) advances in technology in terms of provision of deep brain electrodes and implantable pulse generators; and (iii) safety and public acceptability issues which favour a non-destructive, reversible technique (such as neuromodulation) to lesioning. Other authors have also noticed the higher incidence of persistent neurological deficits in patients receiving lesional surgery suggesting the move towards deep brain stimulation.[15] This too has important implications on prospective planning for funding of neurosurgery, especially given the high initial, and then maintenance, costs of neurostimulation.

Spinal surgery has similarly changed in nature; whereas the total number of spinal operations is similar between the two dates, the use of instrumentation has greatly increased (39% increase in our study interval) with implications for training of neurosurgeons and potential emergence of spinal surgery as a specialty in its own right, as well as for the organisation of neurosurgical practice given the costs involved. Instrumentation has provided better functional outcomes in spinal neurosurgery justifying such a shift in practice.[16,17] Due to the ageing population, other studies have also demonstrated an increase in the work-load for degenerative spine surgery.[18] The trend towards more operations occurring for lumbar degenerative disease cannot being explained easily by our data, although we might hypothesise that it is due to the ageing population and the biomechanics of the ageing spine. Similar trends for restorative surgery have been observed in other specialties.[19]

We also observed a moderate increase in surgery for refractory epilepsy; this has also been highlighted by other studies.[20,21] The increase noted in the use of cranioplasty in our institution may be explained both by the current trend towards more aggressive surgical treatment of head-injured patients including performing craniectomies as well as by the social expectation of acceptable cosmetic results which is achievable by the use of modern cranioplasty material.[22] Finally, microvascular decompression achieves high patient satisfaction justifying the shift to an operative management of trigeminal neuralgia and hemifacial spasm.[23]

We do not know, at present, whether the reported change in our institution reflects change in other UK institutions. Such data retrieval is not possible on a national scale as there is not, currently, a computerised system of admission or discharges. This might change with the pay per patient practice recently introduced in the NHS which may provide national data. In the absence of such data, our database provides a 'surrogate' cohort that may be extrapolatable.

Although analysis of outcome was beyond the scope of this retrospective process audit, clearly it would be of great importance and interest to know if the changes in practice were paralleled with changes in outcome. Prospective databases will be essential in facilitating such studies. Within the previously mentioned limitations, this study demonstrates significant trends which we believe is of importance both for healthcare policy makers and those concerned with neurosurgical training.

Conclusions

Neurosurgery is an evolving speciality. There have been great changes in the previous decades and it is likely that the rate of change will increase further given the speed of technological advancement, modernisation of surgical training, revolution in working hours and work patterns, as well as socio-economic factors and often changing government policies. The healthcare policy makers need to be aware of this and the healthcare provisions need to cater for the demands. It is only through such a pro-active system that we can provide our patients with the service they deserve.

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