Review of Neurosurgery in the Elderly

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The elderly continue to pose increasing demands on the health system, and with an ageing population this issue is sure to persist. This report reviews the work of a neurosurgical unit over a period of 20 years, on patients aged 65 or over.

Firstly details of proportions of elderly presenting to neurosurgical unit over the last 20 years were recorded. Secondly details of patient profiles of the over 65's were compared during the 1983-84 and 1996-7 time periods. This included the patient's age, operative procedures, mortality and length of stay in hospital.

The results were graphically illustrated and the trends and profiles were reported. The results showed an increase in the proportion of elderly presenting for neurosurgical input.

The elderly form a major part of the neurosurgeon's workload and this is likely to increase in the future.

Key Words: craniotomy, elderly, neurosurgery

Brief History of Neurosurgery

Neurosurgery has come a long way since the first medical papyri were written in the seventeenth century by Edwin Smith. Even though evidence of brain surgery dates back to the Neolithic (late Stone Age) period, it was only until the beginning of the 20th century that neurosurgery was recognised as a speciality.

Recent years have seen many changes in the way surgical units are run, such as the proliferation of sub-specialisation among consultants, and the use of multi-disciplinary team approaches to many problems. Inevitably, however, it is the new equipment that catches the eye of the public, and in recent years exciting new technology has expanded and refined the discipline of neurosurgery.

In the last 30 years of the 20th century, the introduction of the microscope to neurosurgery revolutionized the treatment of diseases that were discovered earlier in the century, along with a marked reduction in mortality and morbidity. The discovery of computerized tomography (CT) and magentic resonance imaging (MRI) allowed, for the first time, the direct observations of lesions of the parenchyma; furthermore, these lesions could be precisely localised anatomically and related specifically to clinical changes.[1]

The Elderly and Neurosurgery

The elderly continue to pose increasing demands on the health system, and with an ageing population this issue is sure to persist. Most medical specialities have studied the role they play in the care of the elderly. However, neurosurgery, one of the oldest medical arts, has little documentation concerning geriatric neurosurgery, which continues to grow as a sub-speciality in its own right.

This report reviews the work of a neurosurgical unit over a period of 21 years, on patients aged 65 or over, and report on the trends found therein.

Materials and Methods

For the purpose of this study, an elderly person is defined as somebody of an age of 65 or over. This review sets out to investigate two aspects of neurosurgical care:

1) Has there been an increase in admission of elderly patients for neurosurgical procedures?
2) Has the profile of the elderly presenting for neurosurgery changed and to what extent, if any?

In the first instance, neurosurgical patient admissions to Hope hospital, UK from 1979 to 2000 were divided into greater or less than 65 years of age and the proportions

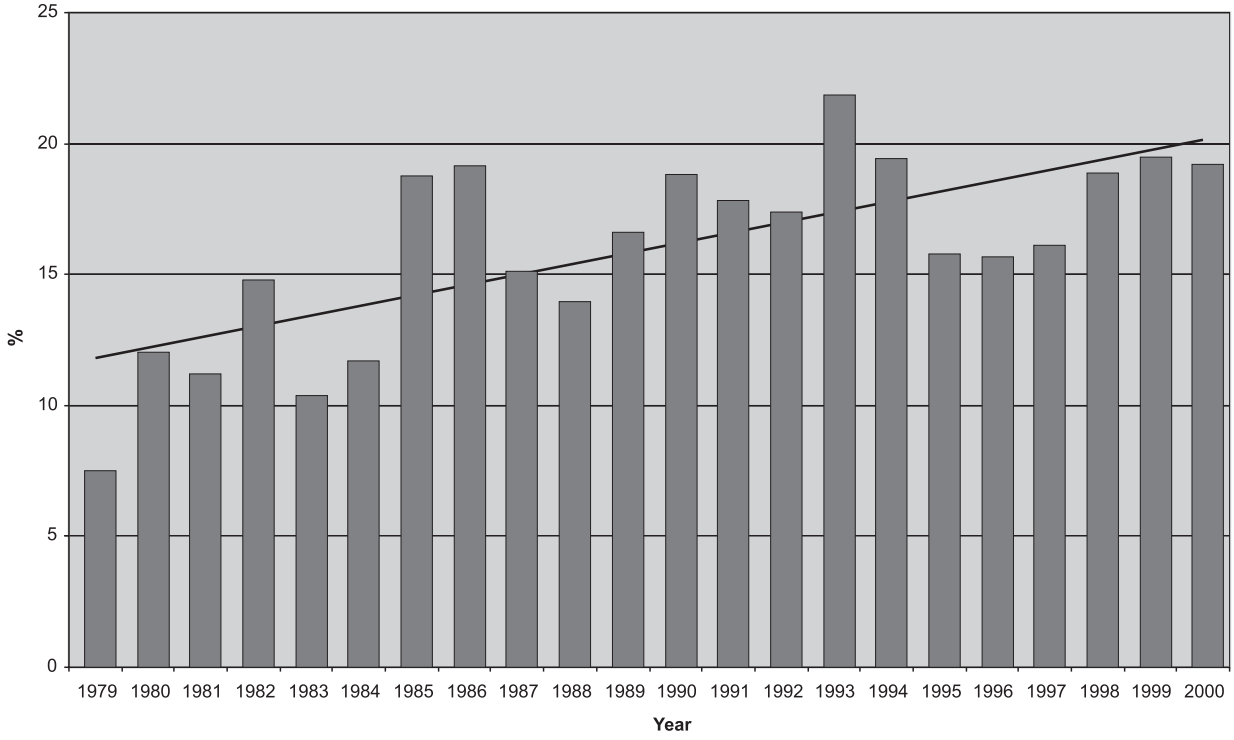

Figure 1. Graph to show the proportion of neurosurical operations done on patients aged 65 or over, between the years 1979 to 2001.

compared over time. Data from The Office of National Statistics[10] was also taken to analyse the elderly proportion of the total population of UK.

For the second, patient profiles of the over 65's were compared during the 1983-4 and 1996-7 time periods. Each patient's age, operative procedures, mortality and length of stay in hospital were tabulated and compared over the periods.

Results

Figure 1 shows the proportion of neurosurgical operations done on elderly patients, between the years of 1979 and 2000. Incorporated in the graph is a linear best-fit line, which clearly shows a gradual increase in the proportions of elderly presenting for neurosurgical intervention. This proportion has increased by approximately 8% over the last 21 years, and looks certain to continue rising.

Figure 2 shows data from The Office for National Statistics. It is evident from the graph that the elderly population have been and will continue growing, albeit slowly. In 1971, the elderly composed about 13% of the population of UK. By around 2000, they represent just under 16% of the population. Although this equates only to a rise of 3% in the elderly, it relates to an absolute increase of over 1.5 million people. The best-fit line on the graph below shows how this trend is going to increase over time.

Thus it is apparent that a rise in elderly population amongst other factors (such as better diagnostic techniques) is responsible for the increase in the elderly presenting for neurosurgery.

Figure 3 shows a comparison of proportions of neurosurgical admissions over two sets of time, separated by thirteen years. It shows, as expected a steady increase in elderly presenting for neurosurgical intervention.

Figure 4 shows a comparison of the post-operative states of neurosurgical patients over 65, between the eras of 1983-4 and 1996-7.

The most striking feature that **Figure 4** shows, is the dramatic decrease in patient death following surgery. While over 10% died in 1983-4, less than 1% died post-operatively in 1996-7. There was a 10% increase in discharge of patients from the hospital over the two eras. Proportions of transfer remained more or less the same.

From the **Table 1**, it can be seen that of all the operations, carried out in the year 1983, 24% were for the removal of meningiomas. The second most prominent operation carried out was a lumbar laminectomy in patients with spondylosis, and comprised 11% of all the procedures. Burr holes for the evacuation of subdural haematomas (SDHs) and clipping of cerebral aneurysms were the next most common procedures, each representing 8% of all the operations.In 1984, lumbar laminectomy for patients with spondylosis comprised the greatest number of operations in the elderly, with a total of 14%. Rhizotomy for trigeminal neuralgia, which was not carried out at all in on elderly patients in 1983, was the second, with a total of 12%. Craniotomy for meningioma and shunt for hydrocephalus each formed 10% of all the operations. It can be concluded thus from the data that lumbar laminectomy and craniotomy for removal of meningioma were the two most prominent neurosurgical

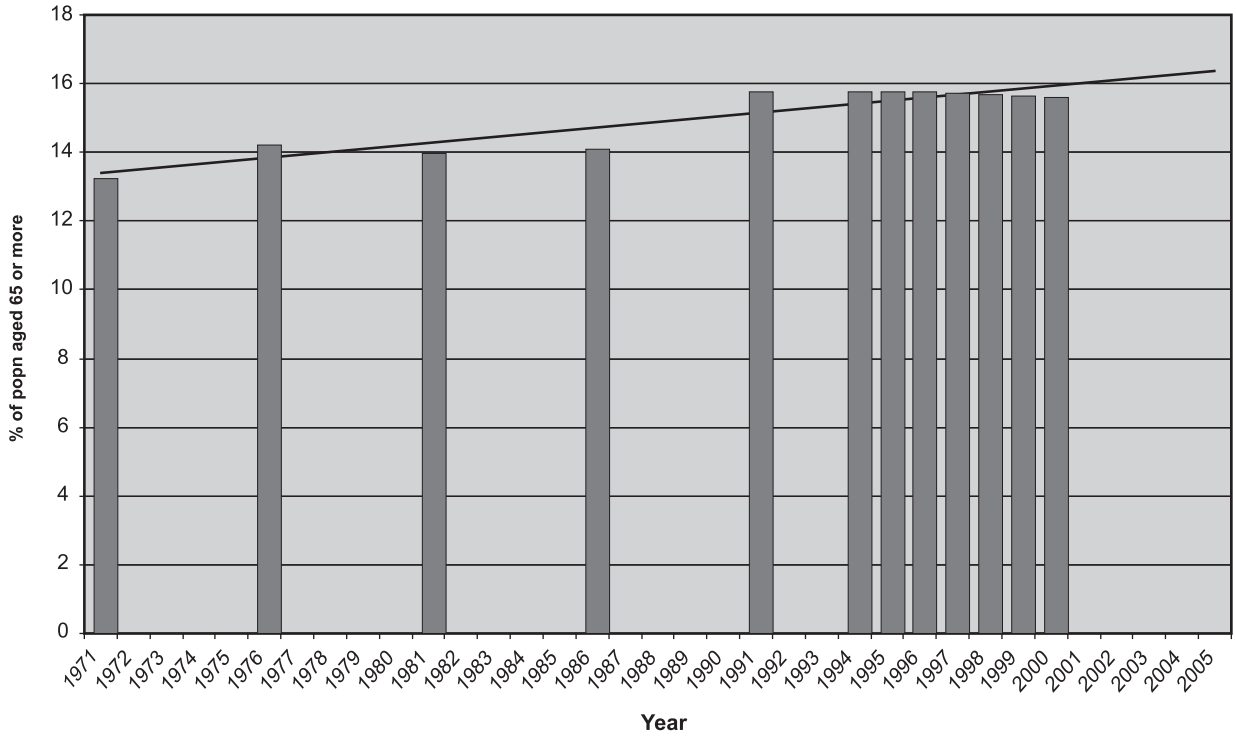

Figure 2. Bargraph to show the proportion of UK population aged 65 or more between 1979 to 2000

operations performed in the elderly in the first era. In 1996, cervical and lumbar laminectomy for spondylosis formed 13% and 12% respectively of all the operations done. Burr hole for evacuating SDH was carried out in 10% of elderly patients. In 1997, it can be seen that again lumbar laminectomy for spondylosis and burr hole evacuation of

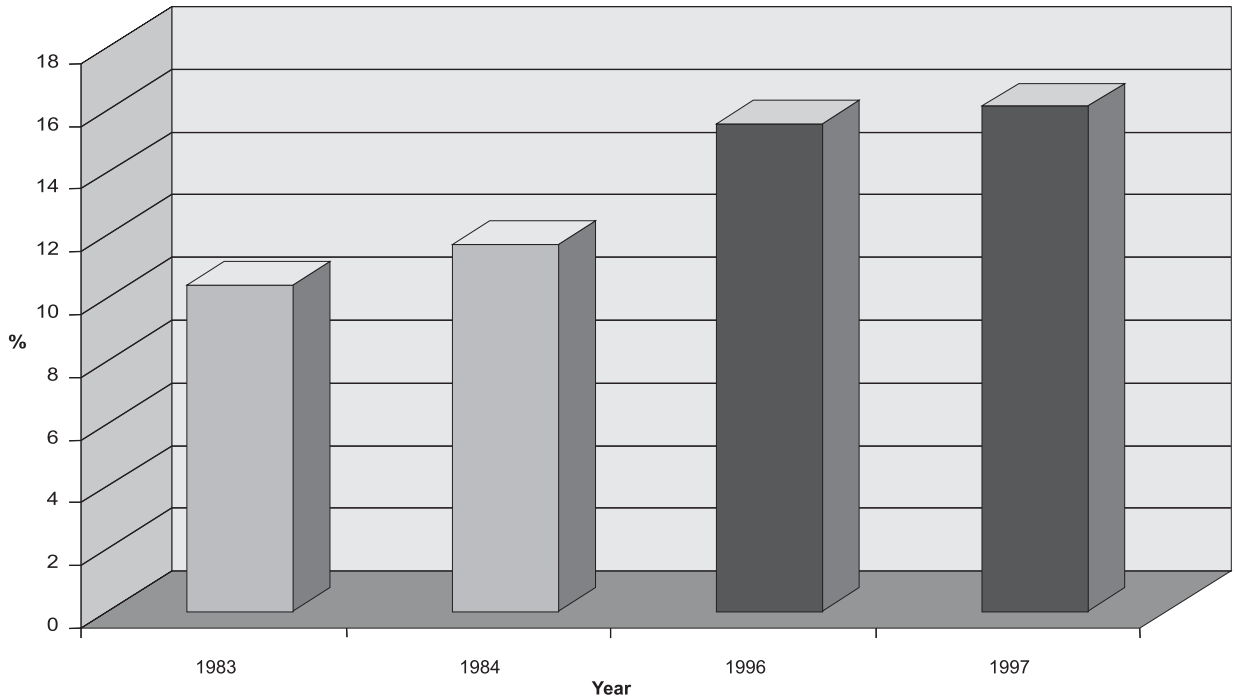

Figure 3. Bar graph to show the percentage of all neurosurgical operation that were done on elderly patients in 1983, 1984, 1996 and 1997.

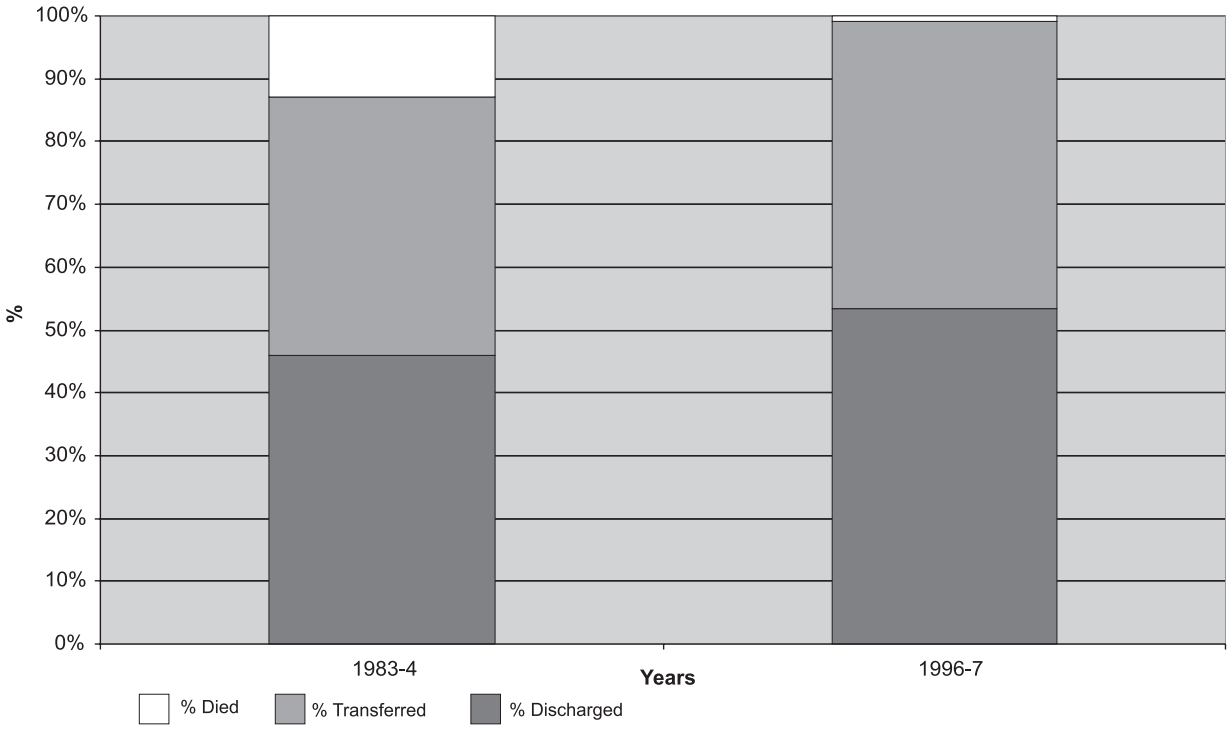

Figure 4. Bar graph comparison of post operative status of neurosurgical patients

SDH formed the majority of operations, each representing 13%. Cervical laminectomy represented 11%. Craniotomy for any tumor removal formed 18% of all the operations performed in the elderly.

Table 2 shows a breakdown of all the major operations performed in the elderly over the two time periods. The results show that laminectomy procedures have generally increased, by about 5% over the two time periods. Cranial procedures as a percentage have decreased by about 3%. Shunt interventions have also decreased by about 4%. Burr hole and vascular operations have only modestly changed, and remain roughly the same. Neural operations have also increased by around 2%.

Table 3 shows a comparison of the average length of stay for some of the major operations between two time periods. This data does not include the length of stay in those patients who subsequently died in hospital, either as a result of the operation, or the underlying condition that admitted them into hospital.

The length of stay for a laminectomy operation dramatically decreases over the two time periods, by approximately 4.2 days. This is echoed in the operations for removal of meningioma, although the decrease is not as striking, but is approximately 1.8 days. The burr hole procedure also required a decreased length of stay, decreasing by just less than a day. Length of stay associated with pituitary removal varied considerably over the two time periods and no real pattern could be deducted. Although rhizotomy operations were not carried out in 1983, there was an obvious decrease in length of stay by approximately 6.3 days.

Discussion

Ageing processes at the molecular and cellular level lead quite understandably to changes in organs. For example, it has been shown that the absolute weight of the liver decreases with increasing age, as does the weight of the kidney. The weight of the brain has long been regarded as the criterion of age dependent changes in that organ. With increasing age the weight of the brain falls significantly. Cerebral circulation decreases after the age of fifty, and at the same time vascular resistance increases. Neurotransmitter levels also change with age. All these changes predispose the elderly to disease processes.[8]

The inevitable process of ageing is a fate that unites all organic matter. However, never has the issue been more apparent than in today's ageing societies, and is set to change the face of healthcare the world over, well into the new millennium.

There has been a slow but sustained increase in the proportion of older persons in the United Kingdom over the last thirty years. Our ever-increasing life expectancy has propagated an increasing burden across medical fields with the elderly already accounting for a dedicated 10% of the £54.2bn allocation for the NHS (National Health Service) across the UK from the budget (although the elderly receive a lot more spending through other parts of the NHS budget).[2]

Although there has been not much change in the number of elderly people over 65 years, an increasing proportion are over 75, and especially 85 years old. It is these latter groups that make the greatest demands on the NHS. However, these population patterns look set to change more dramatically after 2005, as a result of the baby boom

Type of Operation	1983 No's	1983 %	1984 No's	1984 %	1996 No's	1996 %	1997 No's	1997 %
Spinal								
Lumbar Laminectomy for Spondylosis/Decompression	4	11%	7	14%	13	12%	14	13%
Lumbar Fenestration excision of intervertebral disc	0	0%	0	0%	4	4%	1	1%
Lumbar Discectomy	1	3%	4	8%	0	0%	6	6%
Lumbar Laminectomy for tumour	2	5%	0	0%	1	1%	2	2%
Cervical Laminectomy for Spondylosis/Decompression	2	5%	3	6%	14	13%	12	11%
Cervical Discectomy	0	0%	0	0%	5	5%	3	3%
Cervical Laminectomy for tumour	1	3%	0	0%	0	0%	0	0%
Clowards Procedure	0	0%	3	6%	0	0%	0	0%
Thoracic Laminectomy for Spondylosis/Decompression	2	5%	0	0%	2	2%	0	0%
Thoracic Discectomy	0	0%	0	0%	2	2%	0	0%
Thoracic Laminectomy for tumour	0	0%	2	4%	1	1%	1	1%
Cranium								
Craniotomy for Meningioma	9	24%	5	10%	7	7%	10	9%
Craniotomy for other tumours	1	3%	1	2%	8	8%	10	9%
Craniotomy for evacuating SDH	0	0%	1	2%	0	0%	1	1%
Burr Hole for evacuating SDH	3	8%	2	4%	11	10%	14	13%
Burr Hole for hydrocephalus	1	3%	1	2%	0	0%	0	0%
Burr Hole for biopsy of lesion	2	5%	2	4%	0	0%	2	2%
Burr Hole for placing ICP monitor	0	0%	0	0%	1	1%	1	1%
Vascular								
Clipping of aneurysm	3	8%	0	0%	2	2%	2	2%
Arteriography	0	0%	0	0%	3	3%	2	2%
Ligation of Carotid Artery	0	0%	0	0%	0	0%	1	1%
Transluminal Embolisation	0	0%	0	0%	1	1%	0	0%
Neural								
Carpal Tunnel Release	0	0.00%	0	0%	7	7%	4	4%
Rhizotomy for Trigeminal Neuralgia	0	0.00%	6	12%	4	4%	4	4%
Ulnar nerve transposition	1	2.70%	1	2%	0	0%	0	0%
Other surgery on Trigeminal Nerve	2	5.41%	1	2%	2	2%	1	1%
Biopsy of Sural nerve.	0	0.00%	0	0%	1	1%	0	0%
Miscellaneous								
VA shunt for hydrocephalus	1	2.70%	5	10%	0	0%	0	0%
VP shunt for hydrocephalus	0	0.00%	2	4%	6	6%	5	5%
Transethmoidal Pituitary Tumour Removal	1	2.70%	1	2%	0	0%	0	0%
Transphenoidal Pituitary Tumour Removal	0	0.00%	0	0%	3	3%	4	4%
Maintenance of Proximal Catheter of Cerebroventricular shunt	0	0.00%	0	0%	3	3%	1	1%
Other	2	5.41%	3	6%	5	5%	5	5%
TOTAL	38		50		106		106	

Table 1. Numbers and percentages of different neurosurgical operations carried out on patients aged 65 or over, in the years 1983, 1984, 1996 and 1997.

after the second world war, and will further burden the health care system.[9]

The increasing proportion of elderly presenting for neurosurgical intervention can be put down to a number of reason (i) the proportion of elderly are increasing all the time, and account for nearly 16% of the population, compared to 13% over twenty years ago. By the second decade of the next century this will have risen to about 19%. Since most medical conditions increase in frequency with age, hence more elderly will present requiring neurosurgical input. (ii) better techniques – diagnostic; radiographic; curative and understanding of pathophysiologies of disease processes have led to more people being treated than before, hence more people of any age who would not have previously been diagnosed in time, will be treated. (iii) there could have been a change in attitudes of neurosurgeons who might not have thought it to be justifiable to carry out surgery in the elderly two decades ago.

Pennybacker, in 1949 was the first surgeon who observed that the older patients seemed to do no worse than younger ones, at any rates so far as benign tumors were concerned.[5] Many studies since then have reported that age should not be a bar to surgery.[3,4,6]

Operations	1983	1984	1996	1997
Laminectomy	33%	40%	43%	39%
Cranial Procedures	31%	17%	18%	25%
Burr Hole	17%	11%	12%	17%
Shunt - Hydrocephalus	3%	15%	6%	5%
Vascular	8%	0%	6%	5%
Neural	8%	17%	14%	9%

Table 2. Comparison of the proportions of the major operations performed over two sets of time, separated by 13 years.

The increase in neurosurgery in the older age groups over 65, i.e. 75+ over the past thirteen years, reflects the increase in population in this age group over this time period. This combined with better standards of healthcare compared to thirteen years, has led to the age groups above 75 making more requirements of neurosurgical intervention.

There are other problems with which the elderly can present which can affect the prognosis of the condition, such as poor communication, confusion, multiple pathology, polypharmacy, and atypical features of a disease.[3] However, post-operative status of elderly patients over the two eras shows one startling difference. This is the large reduction by 10% in mortality rate. This can be attributed once again to advances made in science and technology, and a overall greater understanding of geriatric medicine. 10% more patients were discharged in 1996-7 than 1983-4, and there was not any significant change in the proportions of patients being transferred to another department within the hospital, to another hospital or some form of long term elderly care center. This increase in discharge rates could again be due to better management techniques, or reflects the strain bed management problems.

Spinal operations by far remain the largest performed neurosurgical operation in the elderly, closely followed by removal of cranial tumors. Compared over the two eras there was a small increase in spinal operations. Neural operations, including rhizotomy for trigeminal neuralgia also slightly increased. Cranial procedures decreased slightly, this was surprising, as one would expect that with an ageing population more patients would require cranial intervention for tumors, which have an increased incidence with age. However, in saying that, in the later period there was a large increase on operations performed on all cranial tumors other than meningiomas. This is again probably due to better diagnostic and operative techniques available, and improved understanding of brain tumors.

Elderly people are more likely to fall - an astonishing 70% of the deaths due to falls occur in the elderly population alone.[7] This has been shown by the consistently large number of elderly required burr hole draining of subdural haematomas in all the years compared.

Decompressive spinal operations, cranial procedures for tumor removal, and burr hole operations for the drainage of subdural haematoma, have consistently remained the three most major neurosurgical operations performed in the elderly over both eras. As all these conditions are invariably related to age, they look to remain the major workload of the neurosurgeon on the elderly.

Operations	1983	1984	1996	1997
Laminectomy	12.78	13.23	10.84	6.85
Craniotomy - Meningioma	15.25	14.00	12.90	12.70
Burr Hole - evacuate SDH	7.33	7.50	6.30	6.64
Pituitary Removal	7.00	18.00	6.66	9.00
Rhizotomy	n/a	8.66	2.50	2.25

Table 3. Comparison of length of stay associated with a particular neurosurgical operation over time.

The average hospital length of stay was calculated for surviving patients in the larger operative groups. The average length of stay in patients requiring all routine operations shortened significantly. There could be a number of reasons for this (i) a greater understanding of the pathophysiology of the condition results in better management methods (ii) the availability of better technology and more effective pharmacy (iii) the constant demand for hospital beds in all departments over time, has greatly affected length of stay (iv) the government's encouragement of prevention of 'bed blocking' by transfer to private nursing and residential homes.

Neurosurgery is a very specialised field of surgery, and also a very expensive one at that. It is important that neurosurgeons are aware as to how much of their work relates to the elderly, and what their profile is likely to be, and how both these are changing over time.

However, it is more important to know whether surgery in this age group, is likely to be of benefit or not.

Inappropriate decisions can lead to wasting of precious resources, and substantially reduce the quality of life of the patient.

Conclusions

In conclusion the following points can be made:

- There has been a continuing increase in the number of elderly patients presenting for neurosurgical intervention.
- This trend is likely to continue well into the millennium.
- Over the last thirteen years
  - there has been an increase in the elderly presenting for neurosurgery. This is especially true in the age groups over 75.
  - mortality rates post-surgically have dramatically decreased.
  - the number of patients discharged after surgery has increased by 10%.
  - removal of cranial tumours and decompressive spinal surgery remain the greatest neurosurgical interventions carried out in the elderly.
  - the length of stay in elderly associated with admission for neurosurgical admission has decreased over time.

It is clear that a large proportion of a neurosurgeon's workload involves the elderly, and this is very likely to increase over time. Sub-specialisation into geriatric neurosurgery is also likely to form in the times to come. Geriatric medicine on the whole is likely to have a major social and financial impact on the health care system of all industrialised countries, a fact which is growing in realisations among health care workers and political figures alike.

References

1. Ausman J: Achievements of the last century in neurosurgery and a view to the 21st Century. **Arch Neurol 57:**61-62, 2000
2. Davies KN: Changing patterns in the care of elderly people. **Brit J Hosp Med 56:**313-314, 1996
3. Hirsh L, Dalton B: Neurosurgery in patients over age 65. **Pa Med 6:**38-42, 1988
4. Maurice-Williams RS: Medical audit and neurosurgery. **Br J Neurosurg 4:**83-86, 1990
5. Maurice-Williams RS: Neurosurgery in the elderly. **Br J Neurosurg 8:**651-653, 1994
6. Maurice-Williams RS, Kitchen N: The scope of neurosurgery for elderly people. **Age Ageing 22:**337-342, 1993
7. O'Brien DP, Nagaria J, Rawluk D: Neurosurgery for the elderly: Facts and Figures. **Gerontology 42:**1-6, 1996
8. Platt D: Biological and medical aspects of aging. **Advances in Neurosurgery 12:**105-108, 1984
9. Raleigh V: The demographic timebomb. **BMJ 315:**442-443, 1997
10. The Office for National Statistics, United Kingdom: **Population Trends.** London, 2001