



An evaluation of the Neurosurgical National Audit Programme case-mix coding framework and attribution of procedures to a consultant neurosurgeon in Hospital Episode Statistics in a single institution

Summary

Neurosurgical procedures are assigned to a consultant neurosurgeon in Hospital Episode Statistics (HES) in 97.1% of elective episodes and 91.9% of emergency episodes.

In records containing a procedure where the main specialty is Neurosurgery, only 0.4% of records were not attributed to a consultant neurosurgeon from the institution.

The National Neurosurgery Audit Programme (NNAP) case-mix coding framework captures almost all neurosurgical procedures. A more concise framework may be required to avoid detecting large numbers of minor procedures or procedures not performed by a neurosurgeon.

Coding errors may attribute neurosurgical procedures to non-neurosurgeons. In this study 25% of all Microvascular Decompression procedures were coding errors. Analysis of unit-level outcomes should include steps to account for errors so that procedure numbers can be accurately defined.

Further studies could establish the accuracy of attribution of procedures to individual neurosurgeons by linking HES data to hospital clinical records or national neurosurgical databases.

Introduction

Hospital Episode Statistics (HES) is the hospital administrative data for English NHS hospitals. It is being used increasingly for medical research, particularly on surgical outcomes.⁽¹⁾ In HES, all hospital admissions are attributed to a healthcare professional responsible for the patient's care. This is recorded in the *consult* variable by the GMC number, or in the case of non-medical professionals another identifier. Each completed episode of care under a consultant is called a Finished Consultant Episode (FCE). If a patient's care is transferred to another consultant in the same admission, then this results in a second FCE and so on. All the FCEs, or episodes, during an admission are grouped together into a Spell. An example of this may be where a patient is admitted under one consultant and their care is subsequently transferred to another consultant



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for specialist care. However, most Spells will contain only one episode. Any procedures that have taken place are attributed to the responsible consultant for the episode in which it took place. If more than one procedure was performed in an episode, then the primary (main) procedure is the one used for the National Neurosurgery Audit Programme (NNAP). This is defined by HES as the most resource intensive procedure.(2)

The NNAP uses HES data to assess the practice of neurosurgeons and neurosurgical units. Specifically, it analyses elective post-operative mortality rates and aims to detect instances of outlying practice. For surgeon-specific data it is not possible to be certain about how accurately procedures are attributed to individual consultant neurosurgeons in HES. It is not practical to check this information against hospital clinical records. This presents a challenge to the veracity of surgeon-specific mortality data. One way that the NNAP deals with this problem is by asking surgeons to validate any instances of post-operative mortality. There is a mechanism for changing errors in case attribution in the audit.

The aims of this report are firstly to explore the proportion of neurosurgical procedures performed in a single institution that are correctly attributed to a consultant neurosurgeon. Secondly, to explore episodes where the dominant procedure is neurosurgical, but the responsible consultant is not a consultant neurosurgeon, or the main specialty is not neurosurgery. Lastly, to determine how comprehensively the NNAP case-mix coding framework identifies neurosurgical activity.

Methods

A three-year period of HES data from April 2015 to March 2018 for a single institution was searched for all episodes that contained a primary neurosurgical procedure (recorded in the *opertn_01* variable). Neurosurgical procedures are defined by the NNAP case-mix framework and are categorised according to subspecialty (see Table 1).(3) All patients 18 years and older were included. The *mainspef* variable, which is the medical specialty of the responsible consultant, was used to search for all episodes under neurosurgery with procedures in all NNAP categories (except for Diagnostic and Non-classified procedures) and the attribution of these episodes to consultants was explored.

Episodes were then divided into elective and urgent/emergency. *Admimeth* values of 11,12 or 13 denote an elective admission. Other values denote a hospital transfer or emergency admission.(2) All primary procedures in the following NNAP categories were included: General & Trauma, Functional, Oncology, CSF disorders, Skull Base, Vascular, Intradural Spine, Dysraphism and Radiosurgery. In this institution all procedures in these categories are only performed by neurosurgeons. Procedures in the other categories such as spinal surgery or peripheral nerve surgery may be carried out by surgeons in other specialties. Therefore, it would not be possible to identify misattribution in this type of analysis. Any procedures in the Diagnostic or Non-classified categories were excluded from analysis as these are not included in the NNAP outlier programme.

Table 1: The 16 NNAP procedure categories and the number of OPCS 4.8 codes in each category.

| NNAP category | Number of OPCS 4.8 Codes |
|---------------------------|--------------------------|
| General and Trauma | 79 |
| Functional | 86 |
| Oncology | 34 |
| CSF disorders | 35 |
| Skull base | 89 |
| Vascular | 88 |
| Intradural Spinal | 25 |
| Dysraphism | 6 |
| Cervical Spinal | 28 |
| Lumbar Spinal | 36 |
| Complex Spinal | 95 |
| Spinal other | 109 |
| Peripheral | 102 |
| Radiosurgery | 1 |
| Diagnostic | 19 |
| Non classified | 38 |
| Total | 870 |

Any records containing primary neurosurgical procedures that were not attributed to a consultant neurosurgeon were explored by calculating the proportions in each NNAP category and identifying the types of neurosurgical procedures. The main medical specialty of these episodes was also explored. The proportion of episodes containing a *mainspef* value for neurosurgery that were not attributed to a neurosurgeon were identified. This is a coding error since the *mainspef* value should be the main specialty of the responsible consultant. Finally, the number and type of primary procedures attributed to consultant neurosurgeons that were not identified by the NNAP case-mix framework were identified.

Results

There were 7,643 records in a single institution over a three-year period with a *mainspef* value for neurosurgery, which included primary procedures in all NNAP categories (except for Diagnostic and Non-classified procedures). Only 31 (0.4%) records were not attributed to a neurosurgeon and these had no valid consultant identifier in *consult*.

The number of episodes containing a neurosurgical primary procedure was 5,785 in the NNAP categories selected for further evaluation (General & Trauma, Functional, Oncology, CSF disorders, Skull Base, Vascular, Intradural Spine, Dysraphism and Radiosurgery). The number of elective and emergency episodes were 4,193 and 1,592, respectively. Of the elective procedures, 1,491 (35.6%) were not attributed to a



consultant neurosurgeon. Of these, the vast majority (n=1369, 91.8%) were in the Functional category. Almost all these Functional procedures (n=1336, 97.6%) comprised minor procedures such as refilling of drug-delivery systems, or pain-management procedures on nerve roots or facet joints of the spine. The remainder were procedures typically used to treat trigeminal neuralgia and the *consult* value indicated that the clinician was a dental or oral surgeon (*consult* value starting with “CD”). The main specialty was neurosurgery in only 0.7% of these episodes and 90% were under neurology, anaesthetics or rehabilitation medicine. Significantly, 15 of the episodes containing the code for microvascular decompression (A323) were attributed to an oral surgeon. The total number of primary procedures coded using A323 was 59 and the other 44 records were attributed to a single neurosurgeon.

The remaining 152 (3.7%) elective procedures that were not attributed to a neurosurgeon were spread amongst the other NNAP categories (Figure 1). Only nine records had no value in *consult* (indicating a coding error or lack of information in the clinical notes), 22 were values indicating a dentist or oral surgeon was the responsible clinician, and the remainder were consultants in other specialties. The main specialties recorded for these elective procedures are displayed in Figure 2. Most were stereotactic radiosurgery (STRS) attributed to ophthalmologists or oncologists, procedures to treat trigeminal neuralgia or optic nerve disorders, lumbar drainage procedures and interventional neuroradiology procedures.

Of the emergency episodes, 129 (8.1%) were not attributed to a neurosurgeon. The procedures were spread across NNAP categories shown in Figure 3. Only three episodes had a *mainspef* value for neurosurgery but no values in *consult*, indicating the patients were under the care of a neurosurgeon but the individual consultant is not recorded. The remainder were consultants in other specialties. The commonest *mainspef* values were for neurology (38%), orthopaedics (9.3%), general medicine (7.8%) and infectious diseases (7.8%), shown in Figure 4.

Figure1: NNAP category for 152 elective admissions with a primary neurosurgical procedure which was not attributed to a Consultant Neurosurgeon, April 2015 – March 2018. Note: Certain Functional procedures were excluded (see results).

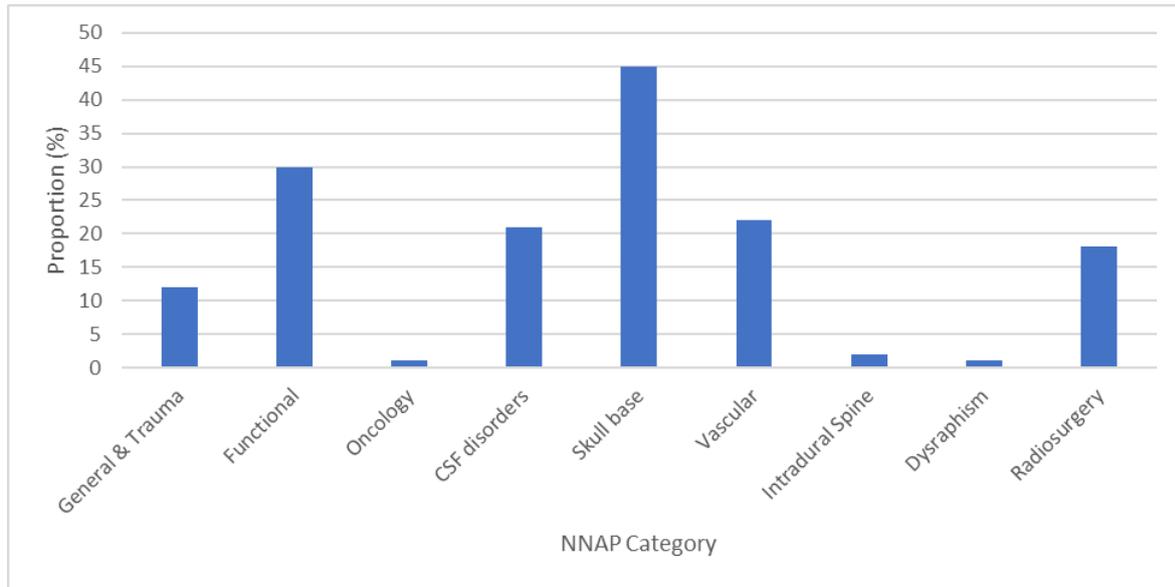


Figure 2: Main specialty for 152 elective admissions with a primary neurosurgical procedure not attributed to a Consultant Neurosurgeon, April 2015 – March 2018. Note: Certain Functional procedures were excluded (see results).

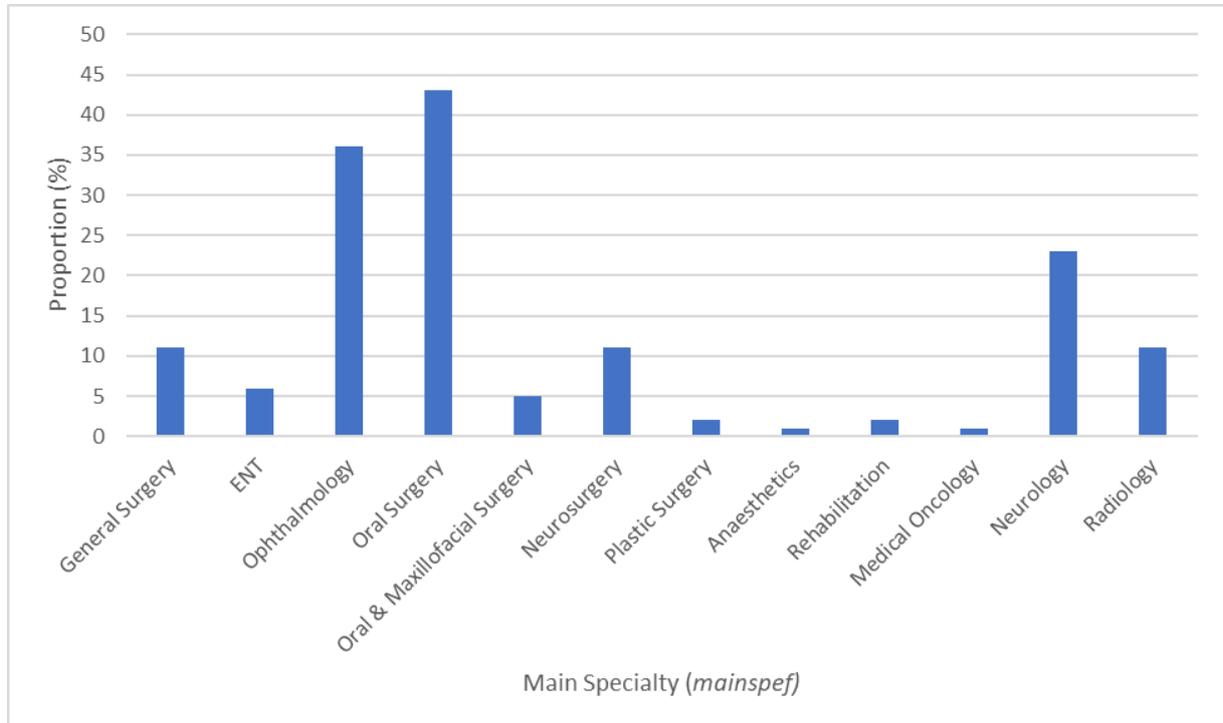


Figure 3: NNAP category for 129 emergency admissions with a primary neurosurgical procedure which was not attributed to a Consultant Neurosurgeon, April 2015 – March 2018.

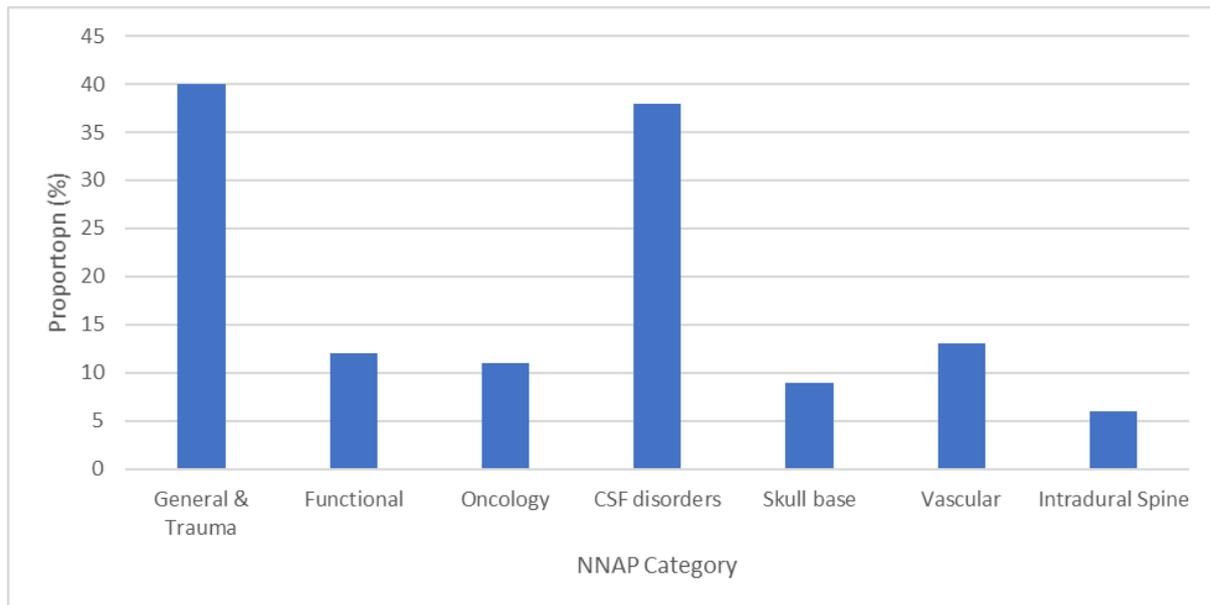


Figure 4: Main specialty for 129 emergency admissions with a primary neurosurgical procedure not attributed to a Consultant Neurosurgeon, April 2015 – March 2018.

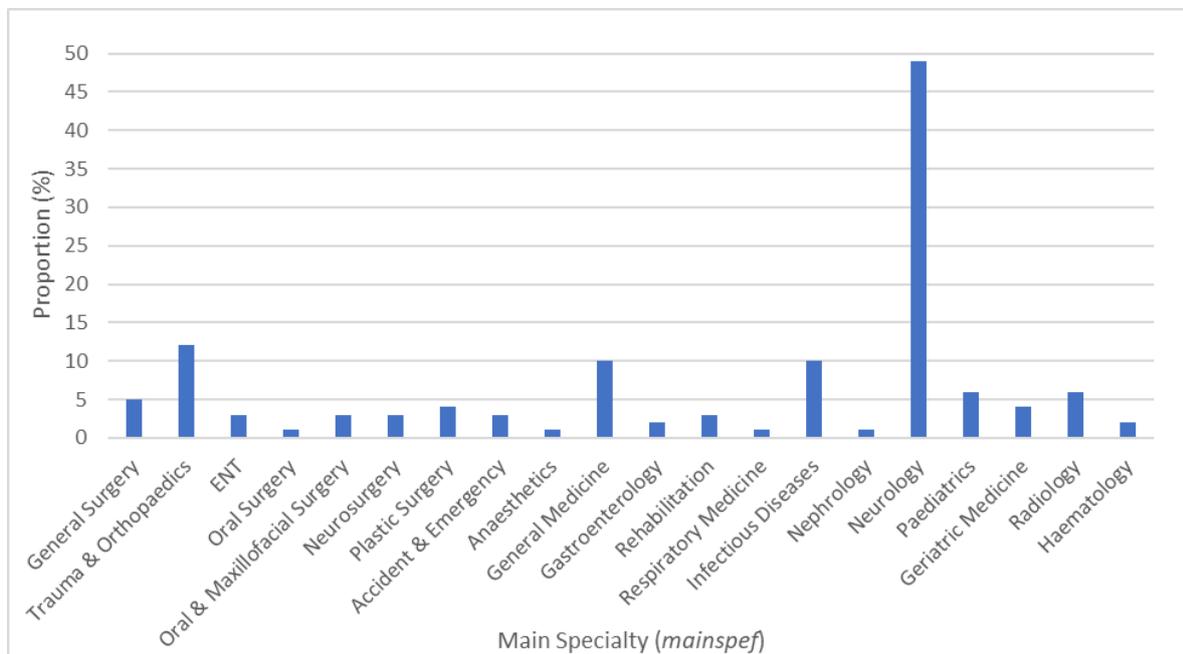


Table 2 shows that there were 3,754 procedures attributed to a consultant neurosurgeon that were not identified when HES was searched using the NNAP case-mix coding framework.(3) Over 61% had a single radiotherapy code (X677) as the primary procedure. Further analysis indicated that the responsible consultant was one of the stereotactic radiosurgeons. There is a code for STRS in OPCS 4.8: A107 –

'Stereotactic Radiosurgery on tissue of brain' which is included in the coding framework. It is probable that episodes with X677 as the primary procedure are miscoded STRS episodes. Non-invasive diagnostic imaging procedures made up 28.4% of the total. There were approximately 259 episodes with a very large number of different codes but small numbers of each code. These episodes were not explored any further.

Table 2: Primary procedures attributed to a Consultant Neurosurgeon but not identified by the NNAP coding framework. Codes with a proportion of less than 0.5% of the total have been grouped together under 'Other'.

| OPCS 4.8 Code | Description | n | % |
|---------------|--|-------------|------------|
| X67 | Preparation for complex conformal radiotherapy | 2322 | 61.9 |
| U05 | Diagnostic imaging of central nervous system | 562 | 15.0 |
| U21 | Diagnostic imaging procedures | 392 | 10.4 |
| U11 | Diagnostic imaging of vascular system | 112 | 3.0 |
| E85 | Ventilation support | 44 | 1.2 |
| M47 | Urethral catheterisation of bladder | 45 | 1.2 |
| L71 / L72 | Therapeutic / Diagnostic transluminal operations on other artery | 18 | 0.5 |
| Other | Various procedures, proportion <0.5% | 259 | 6.9 |
| Total | | 3754 | 100 |

Discussion

Only 0.4% of episodes containing a neurosurgical procedure, excluding Diagnostic and Non-classified procedures, with neurosurgery as the main specialty were not attributed to a neurosurgeon. This means the NNAP case-mix coding framework can attribute almost all neurosurgical activity to a named neurosurgeon using HES.

Of the selected NNAP categories studied in more depth, 97.1% of elective neurosurgical activity was attributed to a consultant neurosurgeon when minor procedures in the Functional category are excluded. These Functional procedures are seldom performed by a neurosurgeon in this institution and should be excluded from analysis of unit-level outcomes. There may be further minor procedures in other categories that could be excluded but there are likely to be relatively small numbers and the process of filtering all the individual codes would be too onerous to perform in practice.

Of the emergency admissions, 91.9% of episodes were attributed to a consultant neurosurgeon. Minor procedures in emergency admissions were not detected in large numbers. A lower proportion of attribution for emergency admission would be



expected, due to the nature of the conditions being treated such as multiple trauma, patients presenting via other specialties or joint care for complex acute admissions.

Overall, a high proportion of neurosurgical activity that is relevant to NNAP is being correctly attributed to neurosurgeons. It is not possible in this analysis to comment on whether activity is correctly attributed to one or another neurosurgeon. In most uncomplicated admissions involving one neurosurgeon it is probably correct. However, in admissions involving complications or mortality, more than one surgeon, or a long admission, attribution to a responsible consultant may not be straight-forward. Surgeons have the opportunity to review mortality attributed to them through the NNAP validation process. But the accuracy of attribution of overall cases, which may affect surgeon-specific mortality rates, is an area that requires further investigation. A Royal College of Surgeons of England report on the use of HES for revalidation has recognised the difficulty of identifying the responsible consultant and dealing with shared care and multidisciplinary team working. It recommended that checks on data quality and completeness are performed before HES data is used to assess surgeons' performance.(4)

The coding framework appears to capture large numbers of procedures that are not usually performed by a neurosurgeon; 35.6% of all elective activity captured by the coding framework in this institution. Almost all these procedures were in the Functional category and most were minor procedures such as refiling of drug-delivery systems or pain-management procedures. It is important to exclude these procedures from any analysis of unit-level outcomes. Given that neurosurgery was the main specialty in only 0.7% of these episodes, procedures such as these can be excluded by filtering by the main specialty. Alternatively, the coding framework could be modified to exclude them completely.

There were 122 procedures remaining after exclusion of these records. Further analysis is required to determine if these procedures are relevant to the NNAP or if they are coding errors. For example, some procedures on the trigeminal or optic nerves could have been performed by surgeons from other specialties, such as freezing or sectioning of peripheral branches of the trigeminal nerve by maxillofacial surgeons. Therefore these episodes have probably not be incorrectly attributed. Again, it is important that the coding framework accurately captures neurosurgical activity for the analysis of unit-level outcomes. The inclusion of large numbers of minor procedures could dilute post-operative mortality rates and reduce the effectiveness of the NNAP in detecting outlying practice.

There is evidence that the quality of coding of procedures and diagnoses in HES is good and has improved with time. (5,6) However, coding errors cause problems with the analysis of surgical outcomes. Fifteen episodes contained a code for microvascular decompression (MVD) but were attributed to oral surgeons. This is most likely to be a coding error, where the patients have received some other treatment for trigeminal neuralgia which has been miscoded, such as injection of local anaesthesia. One quarter (15/59) of the episodes where Microvascular Decompression (A232) was the primary procedure in this institution are probably coding errors. This high error rate would affect any evaluation of outcomes from this procedure using HES. This is particularly problematic for small volume procedures, such as MVD, and thus careful analysis of HES is required to avoid errors.



The limitations of this analysis include the lack of verification of attribution to the responsible consultant using hospital records. Errors in attribution would be important when analysing surgeon-specific mortality data and making assessments of quality of care. Asking surgeons to review their own mortality data before publication will go some way to avoiding such errors.

The coding framework detects large numbers of minor procedures, although these are generally not attributed to a neurosurgeon. This could be addressed by focusing on certain index procedures or by building a more concise coding framework.⁽⁴⁾ The value of developing a detailed coding framework for identifying relevant surgical procedures has recently been demonstrated in cardiac surgery.⁽⁷⁾

The quality of coding in HES may vary between institutions and it is not possible to be certain about the quality in other institutions based on this study. It may be possible to analyse the accuracy of attribution to the responsible consultant by comparing HES data with national neurosurgical clinical databases, as has been done in other surgical specialties.⁽⁴⁾

Conclusions

The NNAP case-mix coding framework is effective at identifying neurosurgical procedures in HES data. Steps must be taken to avoid detecting procedures that are not attributable to neurosurgical activity and to identify possible coding errors that wrongly attribute neurosurgical activity to non-neurosurgeons. The coding framework may need to be refined to account for these issues. Over 97% of elective neurosurgical procedures are attributed to a consultant neurosurgeon, but further work is required to determine the accuracy of attribution to individual neurosurgeons.

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