No association between seniority of surgeon and postoperative recurrence of chronic subdural haematoma

I Phang, R Sivakumaran, MC Papadopoulos

Academic Neurosurgery Unit, St. George's, University of London, UK

ABSTRACT

INTRODUCTION Neurosurgical trainees should achieve competency in chronic subdural haematoma (CSDH) drainage at an early stage in training. The effect of surgeon seniority on recurrence following surgical drainage of CSDH was examined.

METHODS All CSDH cases performed at St George's Hospital in London between March 2009 and March 2012 were analysed. Recurrence was defined as clinical deterioration with computed tomography evidence of CSDH requiring reoperation within six months. The following risk factors were considered: seniority of primary and supervising surgeons, timing of surgery (working hours, outside working hours), patient related factors (age, antiplatelets, warfarin) and operative factors (general vs local anaesthesia, burr holes vs craniotomy, drain use). For recurrent cases, we examined the distance of the cranial opening from the thickest part of the CSDH.

RESULTS A total of 239 patients (median age: 79 years, range: 33–98 years) had 275 CSDH drainage operations. The overall recurrence rate was 13.1%. The median time between the initial procedure and reoperation was 16 days (range: 1–161 days). The only statistically significant risk factor for recurrence was antiplatelets (odds ratio: 2.62, 95% confidence interval: 1.13–6.10, $p < 0.05$). Warfarin, grade of surgeon, timing of surgery, type of anaesthesia, type of operation and use of drains were not significant risk factors. In 26% of recurrent CSDH cases, the burr holes or craniotomy flaps were placed with borderline accuracy.

CONCLUSIONS CSDH drainage is a suitable case for neurosurgical trainees to perform without increasing the chance of recurrence.

KEYWORDS

Chronic subdural haematoma – Graduate medical education – Recurrence

Accepted 4 May 2015

CORRESPONDENCE TO

Marios Papadopoulos, E: mpapadop@sgul.ac.uk

The overall incidence of chronic subdural haematoma (CSDH) is 3.4 in 100,000, rising to 58 in 100,000 in those aged 70 years or older.^{1–3} The overall incidence is projected to double in the next 25 years worldwide because of population aging.⁵ A major problem with CSDH drainage is recurrence, which ranges from 5% to 30%.^{4,5} Owing to the heterogeneity of treatment and patient characteristics, multiple procedure related factors have been examined, including surgical technique, use of drain, drainage duration, postoperative positioning and subdural irrigation.⁶ Patient related risk factors that have been reported include postoperative enoxaparin⁷ and perioperative aspirin use.^{8,9} The effect of surgeon seniority as a risk factor is controversial. Of two studies that examined surgeon seniority, one found no difference in recurrence¹⁰ and the other found reduced recurrence when neurosurgical residents operated on CSDH.¹¹

CSDH drainage remains one of the neurosurgical procedures in which competence is required in the early years

of neurosurgical training in the UK¹² and the US.¹⁵ The various operative techniques available for treatment (twist drill opening, burr hole, mini or full craniotomy) make CSDH an ideal case for neurosurgical residents in the early years of training. As such, CSDHs are often drained by trainee neurosurgeons. The role of training has to be balanced against the morbidity of recurrence. This study examined the effect of seniority of surgeon on the recurrence of CSDH in our department. In the recurrent cases, we examined the position of the cranial opening in the first operation in relation to the CSDH.

Methods

A retrospective analysis was carried out of patients with CSDH between March 2009 and March 2012 using case records and neurosurgical operating theatre logbooks at St George's Hospital, which serves a population of about 3 million in southwest London. The following details were

recorded for each patient: age, sex, antiplatelet or warfarin use, seniority of primary surgeon, seniority of supervising surgeon, timing of surgery, type of anaesthesia, type of operation, unilateral versus bilateral CSDH and use of drain.

Recurrence was defined as clinical deterioration with CSDH on computed tomography (CT) requiring reoperation within six months after the initial drainage procedure. Seniority of primary and supervising surgeon was classified as postgraduate training years 1–3 (junior resident), training years 4–8 (resident) or consultant. Timing of surgery was classified as working hours (8am – 5.59pm) or out of hours (6pm – 7.59am) on weekdays and weekends. Bilateral CSDHs were treated as one case and drained under the same anaesthetic session.

Inclusion/exclusion criteria

All patients aged 17 years old or older with symptomatic CSDH diagnosed on CT requiring surgical evacuation were included in the study. Patients with ventriculoperitoneal shunts were excluded.

Reversal of anticoagulation/antiplatelet medication

Coagulation parameters were checked routinely prior to surgery. Departmental protocol was aimed at maintaining platelets at $>100 \times 10^9/\text{dl}$ and an international normalised ratio of ≤ 1.2 . Coagulation abnormalities were actively reversed preoperatively with prothrombin complex concentrate or fresh frozen plasma. Antiplatelet medication was stopped 5–7 days prior to surgery; if urgent surgery was required, one unit of platelet concentrate was administered perioperatively.

Surgical procedure

The choice of surgical procedure (one or two burr holes, or craniotomy) and the decision to use drains were left to the discretion of the supervising surgeon. For burr hole drainage, the following procedure was used: One or two 14mm burr holes were made targeting the maximum thickness of the CSDH. The dura was opened and coagulated. Warm 0.9% saline was used to irrigate the subdural space until the fluid was clear. Any membranes accessible via the burr hole were opened and coagulated. An external ventricular catheter was used as a subdural drain (Medtronic, Watford, UK) or a subgaleal drain (Summit Medical, Bourton-on-the-Water, UK) was positioned over a burr hole.

Mini-craniotomy was performed as follows: A linear scalp incision was made, followed by a 5cm diameter bone flap. After a cruciate durotomy and coagulation of the dural edges, the CSDH membranes were opened and the subdural space was irrigated with warm 0.9% saline until the fluid was clear. If the brain failed to expand, a subdural drain was inserted.

Burr hole/craniotomy placement accuracy

Analysis of the CT was performed using multiplanar reformatting of the images. For a single burr hole, we measured the distance (d_1) between the thickest part of the CSDH and the burr hole. For two burr holes, we measured the

distance (d_2) between the thickest part of the CSDH and the midpoint between the two burr holes. For craniotomy flaps, we measured the distance (d_3) between the thickest part of the CSDH and the centre of the flap.

The distances (d_{1-3}) are expressed as a percentage of the normalised radius of the CSDH. Cranial access was classed as good ($d_{1-3} \leq 25\%$), borderline ($25\% < d_{1-3} \leq 50\%$) or bad ($d_{1-3} > 50\%$) in either the anteroposterior or craniocaudal dimension. In the case of two burr holes, if the distance between the burr holes was greater than the length of the CSDH, then cranial access was classed as bad, regardless of d_2 .

Statistical analysis

Logistic regression was performed on the patient, procedure and surgeon variables with recurrence as a binomial dependent outcome. Continuous variables were checked for normality with the Kolmogorov–Smirnov test and tested using Student's t-test. Categorical data were analysed with the chi-squared test. Statistical analyses were performed using SPSS® version 20 (IBM, New York, US) and significance was taken at $p < 0.05$.

Results

Table 1 summarises the patient demographics. Antiplatelets, warfarin and alcohol use as well as the timing of surgery, seniority of surgeon, side of CSDH, general anaesthesia, type of operation and type of drains are also shown in Table 1. The study population consisted of 239 consecutive patients with surgically treated CSDH who had 275 operations in total, including 239 primary and 36 recurrent procedures, giving a recurrence rate of 13.1%. Most of the patients were male and elderly. There were no postoperative infections or intracranial haemorrhages in the recurrent group. There was one postoperative subdural empyema in the non-recurrent group.

Risk factors for recurrence

Table 2 compares the frequency of different characteristics in the recurrent versus the non-recurrent CSDH cases. There was a statistically significant difference in antiplatelet use between the recurrence and non-recurrence groups (odds ratio: 2.53, 95% confidence interval: 1.21–5.31, $p < 0.05$). There was no difference in the other variables, in particular timing of operation, seniority of primary surgeon, seniority of supervising surgeon, type of operation or drain use. Of the recurrent cases, burr holes were converted to craniotomy in 9/21 cases and a second burr hole was added in one case treated initially with one burr hole. The median time from initial surgery to surgery for recurrent CSDH was 28 days (range: 0–153 days).

Burr hole/craniotomy placement accuracy

Our study also investigated whether poor cranial access might have led to CSDH recurrence. CT was available for analysis in 27/36 cases. Cranial access was good in 15/27 (56%) and borderline in 12/27 cases (44%) ($p < 0.001$). None were classified as bad.

Table 1 Characteristics of the 239 CSDH patients

	Characteristic	n	%
Patients	Operations (recurrences)	275 (36)	
	Male	187	68.0
	Median age (range)	79 (33–98)	
Clotting	Antiplatelets	62	22.5
	Warfarin	51	18.5
	Alcohol	12	4.4
Surgeons	Primary surgeon: JRes / Res / Cons	74 / 195 / 6	26.9 / 70.9 / 2.2
	Most senior in theatre: JRes / Res / Cons	1 / 242 / 32	0.4 / 88.0 / 11.6
Timing*	Working hours / out of hours	110 / 79	58.2 / 41.8
CSDH	Side: Right / left / bilateral	114 / 116 / 45	41.5 / 42.2 / 45.0
Operation	General / local anaesthesia	205 / 70	74.5 / 25.5
	1 burr hole / 2 burr holes / craniotomy	36 / 199 / 40	13.1 / 72.4 / 14/5
	Drain: Subgaleal / subdural / nil	126 / 93 / 56	45.8 / 33.8 / 20.4

CDSH = chronic subdural haematoma; JRes = junior resident; Res = senior resident; Cons = consultant *Data for 189/239 patients (68.7%)

Table 2 Characteristics of the recurrent and non-recurrent chronic subdural haematoma groups

	Recurrent (n=36)	Non-recurrent (n=239)	p-value
Median age (range)	79 (56–91)	78 (33–98)	>0.05
Antiplatelet use	14 (38.9%)	48 (20.1%)	0.03
Warfarin use	6 (16.7%)	45 (18.8%)	>0.05
Alcohol	2 (5.6%)	10 (4.2%)	>0.05
Timing: Working hours / out of hours*	13 / 12	97 / 67	>0.05
Primary surgeon: JRes / Res / Cons	4 / 32 / 0	70 / 163 / 6	>0.05
Most senior in theatre: JRes / Res / Cons	0 / 33 / 3	1 / 209 / 29	>0.05
Side of haematoma: Unilateral / bilateral	30 / 6	200 / 39	>0.05
General / local anaesthesia	26 / 10	179 / 60	>0.05
1 burr hole / 2 burr holes / craniotomy	0 / 29 / 7	36 / 170 / 33	>0.05
Drain: Subgaleal / subdural / nil	18 / 11 / 7	108 / 82 / 49	>0.05

JRes = junior resident; Res = senior resident; Cons = consultant *Data for 189/239 patients (68.7%)

The craniotomy flap covered the thickest part of the CSDH in 5/6 cases (83%). Craniotomy placement was more accurate than burr hole placement ($p<0.01$). Cranial access in patients who received antiplatelet drugs and had recurrence was good in 6/7 (86%) and borderline in 1/7 cases (14%).

Among the 15 cases with good cranial access, 1 patient was operated on by a consultant as the primary surgeon. Similarly, the primary surgeon was a consultant for 1 of the 12 cases for which cranial access was classified as borderline. The remaining patients were operated on by residents.

Discussion

There were several interesting findings. First, surgeon seniority made no significant difference in the recurrence of CSDH in our series. Second, the use of antiplatelet medication led to a 2.5-fold increase in the risk of recurrence. Third, operating out of hours did not increase the risk of recurrence. Fourth, the use of drains during surgery did not reduce the chance of recurrence. Finally, there was evidence of suboptimal surgical technique in cases of recurrent CSDH (ie burr holes placed with only borderline accuracy).

Surgeon seniority made no difference in the recurrence of CSDH in our unit where junior residents operate under direct supervision from a resident or a consultant. Competency in evacuation of CSDH in trauma neurosurgery is specified in the UK and US neurosurgical curricula at an early stage in training.^{12,13} The identical recurrence rates make CSDH evacuation ideal cases for learning cranial access.

Our finding of antiplatelet medication affecting recurrence rates replicates that found in other studies.^{14,15} In our unit, antiplatelet medication is stopped for at least five days preoperatively if the patient is clinically stable and it is restarted two weeks postoperatively. The restarting of aspirin therefore generally preceded recurrence (median time to recurrence 28 days). Surprisingly, warfarin did not influence recurrence rates in our study. Warfarin is withheld postoperatively if it is given for stroke prophylaxis in atrial fibrillation and it is restarted without reloading if it is given for venous or mechanical heart valve thromboprophylaxis, allowing for a gradual rise in international normalised ratio.

Out-of-hours evacuation of CSDH had no effect on recurrence in our series. CSDH patients are transferred to our unit and listed at the end of elective operating lists on the same day if they are clinically stable. This reduces interruption of elective lists as well as the amount of time a patient is kept fasted. The National Confidential Enquiry into Perioperative

Deaths has suggested that out-of-hours surgery leads to poorer outcomes and has made recommendations regarding non-elective surgery.¹⁶ Our data for CSDH cases do not support poorer outcomes measured by recurrence.

Our recurrence rate is within accepted limits^{17–19} with no difference between drains or no drains. Our study mostly took place after the publication of Santarius *et al*¹⁷ and had a comparable number of study subjects. The change in practice introduced by Santarius *et al* may have led to better identification of patients who would benefit from drainage (ie those whose brains fail to expand towards the surface after CSDH evacuation).

Cranial access accuracy was satisfactory in over half of the cases and borderline in the rest. Our data do not show a difference in the degree of cranial access accuracy between consultants and residents in the subgroup of patients with recurrent CSDH for whom CT was available for review. As it was not possible to obtain the CT of all the patients with recurrence and postoperative CT was not performed routinely after CSDH evacuation, our conclusion is only valid for this subgroup of patients.

Study limitations

There are a few limitations of this retrospective study. As patients are sent back to their regional referring hospital for

ongoing rehabilitation soon after their operation, some data were not available, such as the restarting of antiplatelet or anticoagulation medication. Mortality and morbidity data were also incomplete as patients were not followed up routinely in the neurosurgical clinic unless specifically requested by their general practitioner or referring physician.

Conclusions

In our unit, CSDH recurrence is only associated with antiplatelet medication use and it can be concluded that CSDH drainage remains a suitable training case for junior residents under supervision. This is the first study to examine the accuracy of cranial access for CSDH evacuation in a subgroup of recurrent CSDH patients, and it shows variability in the accuracy of burr hole and craniotomy flap placement. The analysis of data by the British Neurosurgical Trainee Research Collaborative study on CSDH²⁰ will undoubtedly provide more information on this common neurosurgical condition.

Acknowledgements

IP and RS are supported by the Neurosciences Research Foundation and the London Deanery. MCP is supported by the Neurosciences Research Foundation and the Guthy-Jackson Charitable Foundation.

References

1. Kudo H, Kuwamura K, Izawa I *et al.* Chronic subdural hematoma in elderly people: present status on Awaji Island and epidemiological prospect. *Neurol Med Chir* 1992; **32**: 207–209.
2. Asghar M, Adhiyaman V, Greenway MW *et al.* Chronic subdural haematoma in the elderly – a North Wales experience. *J R Soc Med* 2002; **95**: 290–292.
3. Ducruet AF, Grobelny BT, Zacharia BE *et al.* The surgical management of chronic subdural hematoma. *Neurosurg Rev* 2012; **35**: 155–169.
4. Weigel R, Schmiedek P, Krauss JK. Outcome of contemporary surgery for chronic subdural haematoma: evidence based review. *J Neurol Neurosurg Psychiatry* 2003; **74**: 937–943.
5. Santarius T, Hutchinson PJ. Chronic subdural haematoma: time to rationalize treatment? *Br J Neurosurg* 2004; **18**: 328–332.
6. Liu W, Bakker NA, Groen RJ. Chronic subdural hematoma: a systematic review and meta-analysis of surgical procedures. *J Neurosurg* 2014; **121**: 665–673.
7. Tahsim-Oglou Y, Beseoglu K, Hänggi D *et al.* Factors predicting recurrence of chronic subdural haematoma: the influence of intraoperative irrigation and low-molecular-weight heparin thromboprophylaxis. *Acta Neurochir* 2012; **154**: 1,063–1,067.
8. Ohba S, Kinoshita Y, Nakagawa T, Murakami H. The risk factors for recurrence of chronic subdural hematoma. *Neurosurg Rev* 2013; **36**: 145–149.
9. Wada M, Yamakami I, Higuchi Y *et al.* Influence of antiplatelet therapy on postoperative recurrence of chronic subdural hematoma: a multicenter retrospective study in 719 patients. *Clin Neurol Neurosurg* 2014; **120**: 49–54.
10. Gastone P, Fabrizia C, Homere M *et al.* Chronic subdural hematoma: results of a homogeneous series of 159 patients operated on by residents. *Neurol India* 2004; **52**: 475–477.
11. Møllergård P, Wisten O. Operations and re-operations for chronic subdural haematomas during a 25-year period in a well defined population. *Acta Neurochir* 1996; **138**: 708–713.
12. Intercollegiate Surgical Curriculum Programme. *The Intercollegiate Surgical Curriculum: Neurosurgery*. London: ISCP; 2010.
13. Neurotrauma and Neurosurgical Critical Care. Congress of Neurological Surgeons. <http://www.cns.org/academic/resident-curriculum-guidelines-neurosurgery/neurosurgical-clinical-topics/neurotrauma-and> (cited September 2015).
14. König SA, Schick U, Döhnert J *et al.* Coagulopathy and outcome in patients with chronic subdural haematoma. *Acta Neurol Scand* 2003; **107**: 110–116.
15. Forster MT, Mathé AK, Senft C *et al.* The influence of preoperative anticoagulation on outcome and quality of life after surgical treatment of chronic subdural hematoma. *J Clin Neurosci* 2010; **17**: 975–979.
16. National Confidential Enquiry into Perioperative Deaths. *The 2003 Report of the National Confidential Enquiry into Perioperative Deaths*. London: NCEPOD; 2003.
17. Santarius T, Kirkpatrick PJ, Ganesan D *et al.* Use of drains versus no drains after burr-hole evacuation of chronic subdural haematoma: a randomised controlled trial. *Lancet* 2009; **374**: 1,067–1,073.
18. Carlsen JG, Cortnum S, Sørensen JC. Recurrence of chronic subdural haematomata with and without post-operative drainage. *Br J Neurosurg* 2011; **25**: 388–390.
19. Almenawer SA, Farrokhyar F, Hong C *et al.* Chronic subdural hematoma management: a systematic review and meta-analysis of 34,829 patients. *Ann Surg* 2014; **259**: 449–457.
20. Kolias AG, Jones TL, Cowie CJ *et al.* A report from the inaugural meeting of the British Neurosurgical Trainee Research Collaborative held in the Royal College of Surgeons of England, 19 October 2012. *Br J Neurosurg* 2013; **27**: 307–310.