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Routine Postoperative CT-Scans After Burr Hole Trepanation for Chronic Subdural Hematoma – Better Before or After Drainage Removal?

Kronik Subdural Hematom İçin Burr Deliği Trepanasyonu Sonrasında Rutin Postoperatif BT Taramaları Drenaj Çıkarılmasından Önce mi Sonra mı Daha İyi Sonuç Verir?

Benjamin BROKINKEL[1], Christian EWELT[1], Markus HOLLING[1], Volker HESSELMANN[2], Walter Leonard HEINDEL[2], Walter STUMMER[1], Bernhard Robert FISCHER[1]

[1]*University Hospital Muenster, Department of Neurosurgery, Muenster, Germany*
[2]*University Hospital Muenster, Institute of Clinical Radiology, Muenster, Germany*

Corresponding Author: Benjamin BROKINKEL / E-mail: benjamin.brokinkel@ukmuenster.de

ABSTRACT

AIM: To evaluate timing of scheduled CT-scans after burr hole trepanation for chronic subdural hematoma (cSDH).

MATERIAL and METHODS: 131 patients with primary cSDH were included. Scheduled CT-scans were performed after burr hole trepanation and placement of a subdural drain. The influence of CT-scanning with or without indwelling drain was analysed regarding subsequent surgery and CT-scans, duration of hospitalization, short- and middle-term follow up by single factor analyses. Subgroup analyses were performed for patients receiving anticoagulant drugs.

RESULTS: Median age was 74 years. Routine CT-scans with indwelling drainage were not shown to be beneficial regarding subsequent burr hole trepanations (p=0.243), craniotomies (p=1.000) and outcome at discharge (p=0.297). Mean duration of hospitalization (11 vs. 8 days, p=0.013) was significantly longer and number of subsequent CT-scans was higher when CT scan was performed with indwelling drain (2.3 vs. 1.4, p=0.001). In middle-term follow-up, beneficial effects of CT-scanning with inlaying drainage could neither be shown. Moreover, advantageous effects of CT-scans with indwelling drains could neither be shown for patients receiving anticoagulant drugs.

CONCLUSION: Scheduled postoperative cranial imaging with indwelling drains was not shown to be beneficial and misses information of intracranial damage inflicted by removal of drains. We thus recommend CT-scanning after drainage removal.

KEYWORDS: cSDH, Chronic subdural hematoma, CT, Computed tomography, Burr hole trepanation

ÖZ

AMAÇ: Kronik subdural hematom (kSDH) için burr deliği trepanasyonu sonrasında planlanmış BT taramalarının zamanlamasını değerlendirmek.

YÖNTEM ve GEREÇLER: Primer KDH durumu olan 131 hasta çalışmaya dahil edilmiştir. Planlanmış BT taramaları burr deliği trepanasyonu ve bir subdural dren yerleştirilmesinden sonra yapılmıştır. BT taramasının bir kalıcı drenle birlikte veya olmadan etkisi sonraki cerrahi ve BT taramaları, hastanede yatma süresi, kısa ve orta dönem takip açısından tek faktör analizleriyle analiz edilmiştir. Antikoagülan ilaçlar alan hastalarda alt grup analizleri yapılmıştır.

BULGULAR: Ortanca yaş 74 yıldır. Kalıcı drenajla rutin BT taramalarının daha sonraki burr deliği trepanasyonları (p=0,243), kraniyotomiler (p=1,000) ve taburcu olma zamanındaki sonuç (p=0,297) açısından faydalı olmadığı gösterilmiştir. BT taraması kalıcı drenle yapıldığında ortalama hastanede yatma süresi önemli ölçüde daha uzun (11 ve 8 gün, p=0,013) ve sonraki BT taramaları sayısı önemli ölçüde daha yüksek (2,3 ve 1,4, p=0,001) olmuştur. Orta dönemli takipte kalıcı drenajla BT taramanın faydalı etkileri gösterilememiştir. Ayrıca BT taramalarının kalıcı drenlerle faydalı etkileri antikoagülan ilaçlar alan hastalarda da gösterilememiştir.

SONUÇ: Kalıcı drenlerle planlanmış postoperatif kraniyal görüntülemenin faydalı olduğu gösterilememiştir ve ayrıca drenlerin çıkarılmasıyla oluşan intrakraniyal hasarı atlar. Bu nedenle BT taramanın dren çıkarıldıktan sonra yapılmasını öneriyoruz.

ANAHTAR SÖZCÜKLER: Kronik subdural hematom, Subdural hematom, BT, Bilgisayarlı tomografi, Burr deliği trepanasyonu

INTRODUCTION

Chronic subdural hematomas are frequent, especially in the elderly, and are expected to reach even a higher incidence regarding demographical change in an aging society (1). Treatment includes twist drill craniotomy and craniotomy. Enlarged burr hole trepanation is regarded an adequate compromise between postoperative morbidity and recurrence and is performed the most frequently, usually followed by insertion of a subdural drain (3, 6, 11). Reported recurrence rates vary from approximately 10-20% demanding an optimized management after primary surgical treatment, especially focusing on postoperative imaging and handling of the inserted drainage (6, 8, 9, 12).

Although there is consensus about the need for early postoperative CT, it is still controversial whether this should be performed while subdural drains remain in situ or after their removal. It is thought that time of drainage removal and residual hematoma can be determined clinically by examining color and amount of drained fluid. Performing *scheduled* CT-scans *after* drain removal may reveal both clinical and subclinical damage caused by removal and, additionally, subclinical early recurrence of cSDH. In contrast, *scheduled* CT-scan with indwelling drains in situ is reasoned by some to give information on whether drains should be removed or left in situ based on residual fluid in order to avoid early hematoma recurrence. According to individual reasoning, management varies among neurosurgeons.

Our aim was to determine outcome differences between patients scanned with or without indwelling subdural drains. We therefore retrospectively compared patients´ outcome after enlarged burr hole trepanation for cSDH in both groups for differences in subsequent surgical therapy, length of hospitalization and clinical outcome at discharge from our neurosurgical ward and the frequency of additional CT-scans. Where available, follow-up in both groups was compared regarding recurrence and clinical outcome. Additionally, separate analyses were performed for patients receiving anticoagulant drugs.

MATERIAL and METHODS

Patients

Our analysis included 131 patients (42 females, 32%; 89 males, 68%) suffering from primary cSDH who were treated with enlarged burr hole trepanation and subsequent placement of a subdural drain in our neurosurgical department from December 2006 until March 2012. Previous cranial operation and performance of CT-scan due to neurological deterioration were the only exclusion criteria. Diagnosis was established by cranial CT- or MRI imaging and substantiated by the intra-operative findings of membranes and dark, motor oil-coloured fluid. Clinical symptoms at admission were headache, focal neurological symptoms (hemiparesis, dys- and aphasia), seizures, impaired consciousness and other, unspecific symptoms. Type of pharmacological anticoagulation (coumarins and platelet aggregation inhibitors) at date of administration was recorded.

Cranial Imaging

If available, data about the thickest diameter and side of hematoma were recorded. All patients received *scheduled* postoperative CT-scans within the first days after surgery with or without indwelling drains according to the preference of the individually responsible surgeon. Drains were usually removed within the first two days after surgery. Patients were excluded when CT imaging was performed for any other indication (e.g. due to new neurological symptoms) or in case of prior cranial surgery (e.g. ventriculo-peritoneal shunting).

Outcome and Follow-up

Length of hospitalization was defined as time from admission until discharge from our neurosurgical wards. Patients were examined for subsequent surgery after CT-scans (craniotomy, burr hole trepanation and over-all surgery subsuming both interventions) and for neurological outcome at discharge (better, equal or worse compared to admission) based on an internal clinical quality control system. If available, middle-term outcome was achieved by clinical examination and radiological imaging and was compared for indication of recurrent surgery and neurological outcome (measured equal to outcome at discharge).

Statistical Analyses

Data were analysed by SPSS Inc. PASW Statistics 18 software and summarized by descriptive statistics. Patients with or without pharmacological anticoagulation were examined separately. Middle-term follow-up in the latter group was only available in 62 patients. Testing included Chi-square tests in single factor analyses for categorical and t-tests for unpaired samples for continuous variables. A p-value <0.05 was considered to be statistically significant.

RESULTS

Patients

Median age for the 131 patients was 74 years (range: 32-92 years) with a distinct male predominance (42 females, 32% and 89 males, 68%). Presenting symptoms were headache in 45%, focal neurological symptoms in 56%, seizures in 5%, impaired consciousness in 22% and other, unspecific symptoms in 54%. There was no difference regarding the presenting symptoms and the performance of the CT-scan with or without indwelling drain. Median time of hospitalization was 8 days with a range from 1 to 31 days. Coagulation was impaired pharmacologically in 60 patients (46%) due to platelet aggregation inhibitors (25 patients, 19%) or coumarins (35 patients, 27%). All patients were initially treated by enlarged burr hole trepanation with subsequent placement of a subdural drain and received postoperative *elective* CT-scanning with a median lag of two days (range from 0-7 days, see below).

Radiological Imaging

Based on primary cranial CT- or MR-imaging, the side of hematoma was available for all patients and localized on the right side in 40 (31%), on the left side in 60 (46%) and bilaterally

in 31 patients (24%). Data about hematomas' largest diameters were obtained from radiological reports and ranged from 0.7 up to 4.5 cm (median diameter: 1.9 cm). Median diameter of residual fluid accumulations on postoperative CT ranged from 0 to 3.9 cm with median diameter of 0.9 cm. First postoperative cranial imaging was performed with inlaying subdural drainage in 79 patients (60%) and without drains in 52 patients (40%). While the median interval from operation to CT-scanning was two days, CT-scans without indwelling drain (mean with four days delay) were performed significantly later as compared to scans showing the drain (mean delay of one days, p=0.000). Side of initial hematoma did not influence the performance of scans with or without drains (p=0.692). Patients with indwelling subdural drain on the second CT scan tended to have thicker hematomas on the initial CT scan (mean diameter 2.1 cm vs. 1.7 cm; p=0.01). The mean number of subsequent CT-scans in patients with indwelling drain on the initial postoperative CT was 2.3 and therefore higher as compared to 1.4 in patients without subdural drain (p=0.001, range 0-12 scans). Patients with inlaying drainage did not differ significantly regarding initial symptoms, sex (p=0.445) and median age (p=0.880) from patients without indwelling drain on elective CT-scans.

Follow-up (Also See Table I and II)

Short-term follow-up was available for all patients. In single factor analyses, age and sex were not predictors for frequency of additional surgery including both burr hole trepanation or craniotomy. Surgery for recurrence was indicated in 19 patients (14.5%), including burr hole trepanation in 13 cases (9.9%) and craniotomy in 6 cases (4.6%). Comparing both groups, there were no statistically significant differences in the frequency of subsequent burr hole trepanation (12.7% vs. 5.8%), craniotomy (5.1% vs. 3.8%), recurrent over-all operation frequency (17.7% with vs. 9.6% without subdural drains on postoperative CT scans, respectively). Median duration of hospitalization among the patients who received the initial CT scan with indwelling drain was 11 days and therefore significantly longer as compared to their counterparts (8 days, p=0.013).

Additionally, no differences between both groups were found concerning neurological outcome at discharge (Table I). The latter was significantly worse in patients achieving second burr hole trepanations (p=0.000) or any additional surgery (p=0.013), but not in patients undergoing craniotomy (p=0.727). Correspondingly, the average duration

Table I: Follow-up Data Including Recurrences, Median Duration of Hospitalization and Short- and Middle-Term Follow-Up

			Subdural drainage		
			in situ	removed	p-value
Recurrent surgery	Burr hole	N	10	3	*n.s.*
		n (%)	13	6	
	Craniotomy	N	4	2	*n.s.*
		n (%)	5	4	
	Overall surgery	N	14	5	*n.s.*
		n (%)	18	10	
Median duration of stay (days)			**11**	**8**	**0.013**
Outcome at discharge*	Improved	N	61	39	*n.s.*
		n (%)	77	75	
	Equal	N	9	10	
		n (%)	11	19	
	Worse	N	9	3	
		n (%)	11	6	
Outcome at middle-term follow-up*	Improved	N	31	21	*n.s.*
		n (%)	84	84	
	Equal	N	2	3	
		n (%)	5	12	
	Worse	N	3	1	
		n (%)	8	4	
	Dead	N	1	0	
		n (%)	3	0	
Recurrence[§]		N	7	6	*n.s.*
		n (%)	19	24	

*Frequency of analyzed short- and middle-term follow-up parameters depending on inlaying subdural drainage on elective, postoperative CT-scan (*****=compared to neurological symptoms at admission; **§**=middle-term follow up; **n.s.**= not statistically significant).*

of hospitalization was prolonged for those who underwent recurrent burr hole trepanation (p=0.004), craniotomy (p=0.006) or over all surgery (p=0.000, Table II).

Middle-term follow-up ranged from 1 to 10 months (median 2 months) and was available for 62 patients. Among these, 13 patients (21%) underwent surgery for recurrence with no differences depending on whether scanning was primarily performed with indwelling subdural drains. Compared to neurological symptoms at admission, 52 patients (84%) had improved, five (8%) were unchanged and 4 (7%) had worse symptoms, while one had died of cardiac arrest subsequent to pulmonal embolism.

Pharmacological Anticoagulation (Subgroup Analyses)

Pharmacological anticoagulation was present in 60 patients at time of admission (46%). Those did not differ regarding sex, initial symptoms, hematoma side or initial hematoma size but were slightly older as compared to non-anticoagulated patients (mean age of 76 vs. 70 years, p=0.002). Preoperative anticoagulation did not significantly impact duration of hospitalization, frequency and width of recurrent hematoma or outcome at discharge. Additionally, anticoagulation therapy did not impact timing (p=0.309) or performance of CT-scan with or without indwelling drains (0.722). The presence of subdural drains in these patients at the time of initial postoperative CT-scanning was neither associated with better short- or middle term outcome nor with an increased frequency of subsequent surgery or with a longer duration of hospitalization. Anyways, absence of drain on scheduled postoperative CT scan was associated with reduced number of subsequent CT scan during hospitalization (mean: 1.4) compared to patients with indwelling drain (mean: 2.4 CT scans, p=0.014, Table III).

DISCUSSION

We could show that *scheduled* postoperative CT-scans with indwelling subdural drain did not significantly impact the rate of additional surgery and did not reduce secondary CT-scans or improved prognosis in the short- or middle-term.

Table II: Outcome after Recurrent Surgery

		No surgery		Burrhole*		Craniotomy*		Over-all Surgery*	
		N	n (%)	N	n (%)	N	n (%)	N	n (%)
Outcome	better	87	78	8	62	5	83	13	68
	equal	18	16	0	0	1	17	1	5
	worse	7	6	5	38	0	0	5	26
	death	0	0	0	0	0	0	0	0
p-value				0.000		0.727		0.013	
Average duration (days)		8		15		22		17	
p-value				0.004		0.006		0.000	

Influence of early recurrent surgery on short-term outcome and duration of hospitalization (=form of second performed surgery).*

Table III: Subgroup Analysis for Anticoagulated Patients

	No subdural Drain in CCT		Subdural Drain in CCT		p-value
	N	n (%)	N	n (%)	
better*	19	76	28	80	
equal*	4	16	4	11	0.876
worse*	2	8	3	9	
total*	25	100	35	100	
mean duration§	8.3		11.1		0.190
CT scans	1.4		2.4		0.014
better*	8	80	17	81	
equal*	1	10	2	9	
worse*	1	10	1	5	0.857
dead*	0	0	1	5	
total*	10	100	21	100	

Short-term neurological outcome and mean duration of hospitalization in patients with oral anticoagulation regarding inlaying subdural drainage on elective, postoperative CT-scan (=compared to neurological symptoms at admission, §=Mean duration in days).*

Moreover, we could show that duration of hospitalization was significantly longer among the patients who had received the CT-scan with indwelling subdural drainage. However, our analyses are insufficient in discriminating this observation from a bias, caused by patients with more sever symptoms. Those neurologically more impaired patients would possibly receive the elective CT-scans closer to the operation and therefore with higher likelihood of indwelling drain and, according to the impairment, would probably stay longer in hospital. Although we could not detect a difference in the kind of symptoms among the patients who received the CT-scan with or without indwelling drain, we did not discriminate the intensity of symptoms that finally prevents the comparability. Anyways, the facts that median duration of hospitalization as well as the median thickness of hematoma on initial CT-scan were significantly increased among the patients with indwelling drain on postoperative CT-scan supports the assumption of a possible bias.

In our study, pharmacologic anticoagulation did not impact the frequency of additional surgery or outcome. This observation is in contrast to other studies that find anticoagulation to be risk factor for primary or recurrent cSDH (1, 2). Corresponding to our analysis, Torashi et al. could not detect pharmacologic anticoagulation as a risk factor for subdural hematoma recurrence so that correlation still remains controversial (10). Among this subgroup performance of CT-scans with indwelling subdural drains appeared not to be beneficial for patients´ outcome at discharge or on middle-term follow-up but was associated with an increased number of subsequent CT-scans.

Additional surgery for recurrence was slightly associated with worse outcome which matches results from Forster et al. (2) and resulted in a doubling of the duration of hospitalization from 9.5 to 19 days. Interestingly, subgroup analyses revealed repeated burr hole trepanation to be more harmful than craniotomy (see *table 2*). While mean duration of hospitalization increased to 22 days in the craniotomy subgroup and therefore longer compared to 17 days in the burr hole subgroup, clinical outcome in short-term was significantly better patients who underwent craniotomy. This finding was surprising because burr hole trepanation is considered to be the less invasive intervention and was shown to be associated with less morbidity compared to craniotomy in primary surgery for cSDH (4-6). In contrast, craniotomy was shown to be more effective in complicated cSDH which may probably be the case in our subgroup of patients undergoing recurrent surgery (3). Thus, craniotomy seems to be justified as the surgical approach to complicated, recurrent cSDH irrespective of its more invasive nature.

The statistical power regarding middle-term follow-up in our study was limited due to the small number of patients with follow-up information. Analyses did not show an indication for CT-scanning with inlaying drainage in order to reduce recurrence or improve outcome. Since the length of drainage duration was not recorded in our study, we focused on basic follow-up benchmarks analyzing recurrent surgery, duration of hospitalization and outcome. Because our analysis was designed retrospectively, patients´ symptoms and outcome were not measured in a standardized, established rating system like the Glasgow Coma Scale (GCS), the Glasgow Outcome Scale (GOS) or the modified Rankin Scan (mRS). This causes difficulties in comparison with other studies evaluating outcome and symptoms basing on these rating systems. Nonetheless, we think our rating system offers a simple way possibility of categorization and is therefore well applicable to compare clinical symptoms during follow-up.

Remnants of subdural fluid can be detected in CT-scans in up to 80% of the patients after burr hole trepanation even without neurological symptoms. Since residual fluid collections might take up to sixth months to be resorbed completely, recurrent surgery for hematoma should be withheld as long as patient shows good recovery (3, 7). Since additional surgery may be necessary in up to 20% of the patients during postoperative follow up (6, 8, 9, 12), early postoperative CT-scans are recommended in order to evaluate the indication requiring additional surgery. Performance of elective, postoperative CT-scans with indwelling subdural drains is used by many for generating information about residual subdural fluid and serves as an instrument for determining the time of drainage removal. Although this management is mainly assumed to avoid early recurrence of cSDH, important information about brain damage or bleeding caused by catheter retraction is often missed.

Since our analyses did not reveal any beneficial effects of *elective early* cranial imaging with indwelling drains, scanning is recommended only after removal of subdural drains. Although our analyses are limited for the abovementioned reasons, we offer a first statistical approach to the controversial topic. The authors explicitly remark that our results are based on our analysis of *scheduled* cranial imaging. Emergency CT-scan should, however, be performed regardless of indwelling drains immediately.

CONCLUSION

Postoperative, *scheduled* CT-scan with indwelling subdural drains could not be shown to be beneficial concerning the short- and middle-term need of recurrent surgery or outcome. In addition, the number of postoperative CT-scans was not reduced and information about either subclinical intracranial damage or early hematoma recurrence may be missed. We therefore recommend *scheduled,* postoperative CT-imaging subsequent to drainage removal.

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