

Factors Independently Associated with the Surgical Indication for Traumatic Extradural Haematoma in a Sub-Saharan Neurosurgical Centre: An Analytical Observational Study

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ABSTRACT: Background. Extradural haematoma (EDH) is a reversible head injury whose outcome depends on timely surgery. It occurs in roughly 2–8% of head injuries and in 5–15% of fatal ones; about 56% of cases are operated worldwide. In sub-Saharan Africa it mostly affects young men injured on motorised two- or three-wheelers, yet what drives the decision to operate there is poorly documented. Objective. To describe EDH as the principal computed-tomography (CT) lesion at Bouaké University Hospital and to identify the clinical and radiological factors independently associated with the decision to operate. Methods. Retrospective single-centre study (STROBE) of an institutional database of consecutive traumatic brain injury admissions (2017–2021: 84 patients; 2025–2026: 36 patients). We analysed patients with EDH as the principal lesion ($n = 120$). The primary outcome was the surgical indication, defined as the operative decision recorded in the medical file before any operation (yes/no). Death and the Glasgow Outcome Scale (GOS) were described. Groups were compared with Mann–Whitney and Fisher tests. Multivariable logistic regression (Glasgow Coma Scale [GCS], CT mass effect, anisocoria, age) identified independent factors; we checked collinearity (variance inflation factors, VIF), discrimination (area under the ROC curve, AUC, bootstrap optimism-corrected) and calibration (Hosmer–Lemeshow test). Analyses used Python (statsmodels). Results. Patients were young (median age 24 years) and mostly male (90.0%); road-traffic crashes caused 84.2% of injuries, mostly involving motorised two- or three-wheelers. Median GCS was 13 and 63.3% of injuries were mild. A surgical indication was recorded in 77 patients (64.2%), 59 of whom had a documented procedure. A lower GCS (adjusted OR 0.70 per point, 95% CI 0.53–0.92) and CT mass effect (adjusted OR 4.40, 95% CI 1.59–12.17) were independently associated with the indication; age and anisocoria were not. Discrimination was modest (AUC 0.72; optimism-corrected 0.69; pseudo- R^2 0.12), the Hosmer–Lemeshow test showed no miscalibration ($p = 0.35$, low power at this sample size) and all VIF were below 1.5. In-hospital mortality was 3.3% (4/120). Of 109 patients with a known GOS (11 missing), 104 (95.4%) had a favourable outcome (GOS 4–5) at the last available assessment. Conclusion. In this young population, mostly injured on motorised two- or three-wheelers, the recorded decision to operate was associated chiefly with initial severity (GCS) and CT mass effect, not with age or the pupillary examination. This fits guideline criteria and is not a new decision rule. The model explains little of the decision: haematoma volume, associated open injuries and reasons for non-operation were not modelled. Mortality was low and functional recovery good. Deaths were too few to model outcome, which is better done on the whole cohort. Multicentre prospective studies should validate this decision profile in other African neurosurgical centres.

KEYWORDS: Extradural haematoma; Traumatic brain injury; Surgical indication; Glasgow Coma Scale; Mass effect; Logistic regression; Road-traffic crash; Côte d'Ivoire; Sub-Saharan Africa.

I. INTRODUCTION

Extradural haematoma (EDH) is the neurosurgical emergency par excellence. Blood, usually arterial, collects between the inner table of the skull and the dura mater. Within hours it can cause herniation and death; evacuated in time, it usually leaves full

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neurological recovery [1] [2]. EDH is found in about 2% of head injuries [1], in more than 8% in Enugu [3], and in 5–15% of fatal head injuries [1]. It mainly strikes working-age adults. Worldwide, slightly more than one patient in two is operated on (56% in the meta-analysis by Rahimi et al. [4]), or nearly 3.1 million operations a year. Prognosis therefore depends less on the collection itself than on how quickly and how soundly the decision to operate is made.

In sub-Saharan Africa the picture is consistent: young men injured in road-traffic crashes (RTCs) involving motorised two- or three-wheelers [5]-[7]. Emergency imaging is harder to reach and patients arrive late [8]; in Enugu the mean time to presentation exceeded 90 hours [3]. Recent European cohorts look different, with a median age of 41 years [9]. Most West African series remain descriptive: epidemiology, management, outcome [10]-[12]. They do not model the decision to operate. Elsewhere, studies focus on prognostic factors in patients already operated on [13].

Mortality in isolated EDH is low: a prognostic model built on it would lack power and say little. The everyday question lies elsewhere: to operate, or not? It is frequent enough to study statistically, and it matters all the more where imaging and theatre time are scarce and must be allocated carefully. We therefore took the surgical indication, that is, the operative decision recorded in the medical file, as our primary outcome. Guidelines rest on haematoma volume and thickness, midline shift and level of consciousness [1]. We ask which of these elements, among those our database contains, account for the decision actually taken. Our aims were to describe the clinical and radiological profile of EDH as the principal lesion at Bouaké University Hospital and to identify the factors independently associated with the decision to operate. We hypothesised that initial neurological severity and mass effect on CT would be those factors.

II. PATIENTS AND METHODS

A. Study Design and Reporting

Single-centre observational study carried out in the neurosurgery department of Bouaké University Hospital (Côte d'Ivoire) and reported according to the STROBE checklist [14] [15]. It is a retrospective analysis of the department's institutional traumatic brain injury (TBI) database, built from the consecutive-admissions register and the operating register. It covers two periods: 2017–2021 (84 patients) and 2025–2026 (36 patients). For the second, pathway variables were collected in a standardised way.

B. Relationship with Other Work from the Same Database

This database feeds other unpublished manuscripts from the department: epidemiology, prognostic factors and prediction models for TBI; the prehospital pathway and admission delays; the paediatric subgroup; and lesion mapping and surgical performance, in which EDH is only one of six subtypes analysed. The present paper retains only EDH as the principal lesion, with its own outcome and its own model. Patients from the recent series appear in several of these manuscripts. We declare this overlap here and in the cover letter, in line with ICMJE recommendations.

C. Population and Definition of the Principal Lesion

From the 1,366 patients in the database, we retained those whose EDH was the principal lesion ($n = 120$). When several focal lesions coexisted, the principal lesion was the one with the greatest mass effect and clinical significance on the admission computed tomography (CT); a fixed rank order broke ties (chronic then acute subdural haematoma, EDH, open depressed fracture with dural breach, depressed skull fracture, then contusion). The neurosurgeon assigned it from the clinical and imaging data recorded at admission, hence before the operative decision and independently of it. It nevertheless rests on the same radiological notion as mass effect, the exposure under study (see IV-F). Five non-predominant EDH (principal lesion other) were excluded. We set no age limit: children and adults are analysed together, with age as an adjustment variable. Paediatric EDH nonetheless has its own features, such as posterior fossa locations [16], and its own series [17] (Figure 1).

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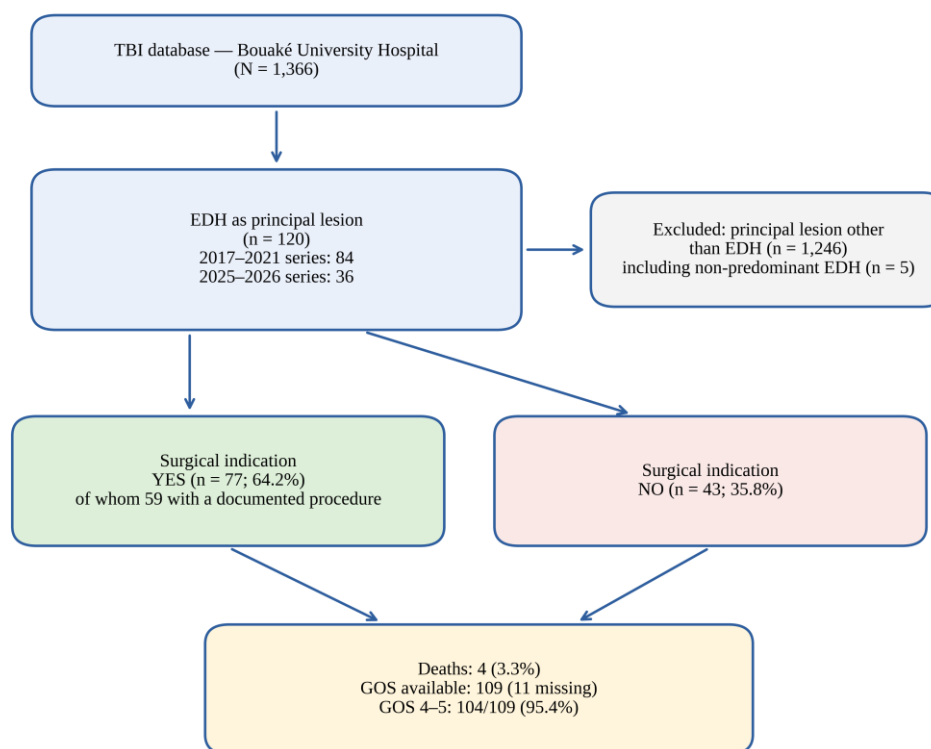


Figure 1. Study flow diagram (STROBE). EDH: extradural haematoma; TBI: traumatic brain injury; GOS: Glasgow Outcome Scale.

D. Variables and Operational Definitions

We defined candidate variables a priori on clinical and pathophysiological grounds: age; Glasgow Coma Scale (GCS) score on admission and the resulting severity (mild 13–15, moderate 9–12, severe ≤ 8); anisocoria; CT mass effect; measured herniation in millimetres; admission delay; and initial loss of consciousness (ILC). Admission delay is the number of whole days between injury and admission to neurosurgery, transfers included (0 if the patient arrived the same day). The date of injury came from the history or the transfer documents; an unknown date was treated as missing. Measured in days, this delay does not capture delays of a few hours, yet these are decisive for lesions that need evacuating; it should be read with caution.

We defined mass effect as at least one CT sign: midline shift, ventricular compression, effacement of the basal cisterns or a sign of herniation, according to the joint reading of the radiologist and the neurosurgeon, in line with the management criteria [1]. The primary outcome is the surgical indication (yes/no): the decision made by the neurosurgeon after clinical examination and reading of the CT, recorded in the medical file before any operation, with reference to international guidelines [1] and to their judgement (volume, thickness, midline shift, level of consciousness). It is the decision, not the act. We describe the procedures entered in the operating register, but we did not analyse separately whether the operation was actually performed, and we do not know the reasons for decisions left without a documented procedure. Secondary outcomes, descriptive, are in-hospital death and functional outcome on the Glasgow Outcome Scale (GOS) at the last available assessment, at a follow-up visit or in the file. Follow-up duration could not be established reliably for the whole series; we do not report it.

E. Pooling of the Two Periods

We pooled the two periods. The department worked throughout with the same team, the same CT scanner and the same principles for indicating surgery in EDH; we identified no major change in imaging protocol, surgical indication or local guidance. The interval 2022–2024, without usable structured collection, is not included. This homogeneity rests on knowledge of the department, not on a comparison of the data. The 120 patients split into 84 (2017–2021) and 36 (2025–2026); the period effect was not tested (see IV-F).

F. Missing Data

The main analysis uses complete data ($n = 120$): no variable of the main model (GCS, mass effect, anisocoria, age) had a missing value. Herniation was missing in 16 patients (13%); we therefore excluded it from the main model and studied it separately, in complete cases ($n = 104$), in a sensitivity analysis. GOS was missing in 11 patients (9.2%); they are excluded from outcome proportions, and we also show the worst case. Nothing was imputed.

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G. Statistical Analysis

We included all eligible consecutive patients in the period; no sample size was calculated a priori. Categorical variables are described as counts and percentages, quantitative variables as median and interquartile range [IQR], their distribution not being normal. Patients with and without a surgical indication were compared with the Mann–Whitney test (continuous variables) and Fisher’s exact test (binary variables). We looked for factors independently associated with the indication by conventional, unpenalised multivariable logistic regression. With 43 patients without an indication, four predictors were possible (10.8 events per variable), following the rule of at least ten events per variable [18]. The main model comprises GCS, mass effect, anisocoria and age. We fixed this choice before estimating the model, on clinical plausibility and the literature, without regard to univariable significance; no analysis protocol was registered. Admission delay and ILC, candidates left out of the model, would have lowered the ratio to about 7 events per variable for six predictors. Herniation, highly correlated with mass effect ($r = 0.89$) and incomplete, also stays out of the main model. We checked collinearity with variance inflation factors (VIF), measured discrimination by the area under the ROC curve (AUC) corrected for optimism by bootstrap (500 resamples) [19], and tested calibration with the Hosmer–Lemeshow test [20]. Outcome (4 deaths) is analysed descriptively, events being too few for a model. The significance threshold is 0.05. Analyses were run in Python (statsmodels [21]).

III. RESULTS

A. Clinical and Radiological Profile

We analysed 120 patients with EDH as the principal lesion. They were young (median age 24 years [IQR 18–35]; range 3–85 years) and almost all male (108, or 90.0%; sex ratio 9:1). RTCs dominated (101 cases, 84.2%), 81 of which involved a motorised two- or three-wheeler; falls (12 cases, 10.0%) and assaults (7 cases, 5.8%) followed. Eighty patients (66.7%) had lost consciousness at the time of injury. Median GCS on admission was 13 [IQR 12–14]: 76 mild injuries (63.3%), 42 moderate (35.0%) and only 2 severe (1.7%). Fifteen patients (12.5%) had anisocoria. CT showed mass effect in 51 cases (42.5%). Median admission delay was 2 days [IQR 1–4], a sign of care pathways that were sometimes prolonged (Table I, Figure 2).

TABLE I. CLINICAL AND RADIOLOGICAL CHARACTERISTICS OF PATIENTS WITH EDH AS THE PRINCIPAL LESION (N = 120).

Characteristic	EDH as principal lesion (n = 120)
Age, years — median [IQR] (range)	24 [18–35] (3–85)
Male sex — n (%)	108 (90.0)
Mechanism — RTC / fall / assault, n of which motorised two- or three-wheeler — n	101 / 12 / 7 81
Initial loss of consciousness — n (%)	80 (66.7)
GCS — median [IQR] (range)	13 [12–14] (7–15)
Severity — mild / moderate / severe, n (%)	76 (63.3) / 42 (35.0) / 2 (1.7)
Anisocoria — n (%)	15 (12.5)
CT mass effect — n (%)	51 (42.5)
Admission delay, days — median [IQR] (max)	2 [1–4] (34)
Surgical indication — n (%)	77 (64.2)
In-hospital death — n (%)	4 (3.3)

IQR: interquartile range; GCS: Glasgow Coma Scale; CT: computed tomography; RTC: road-traffic crash; EDH: extradural haematoma.

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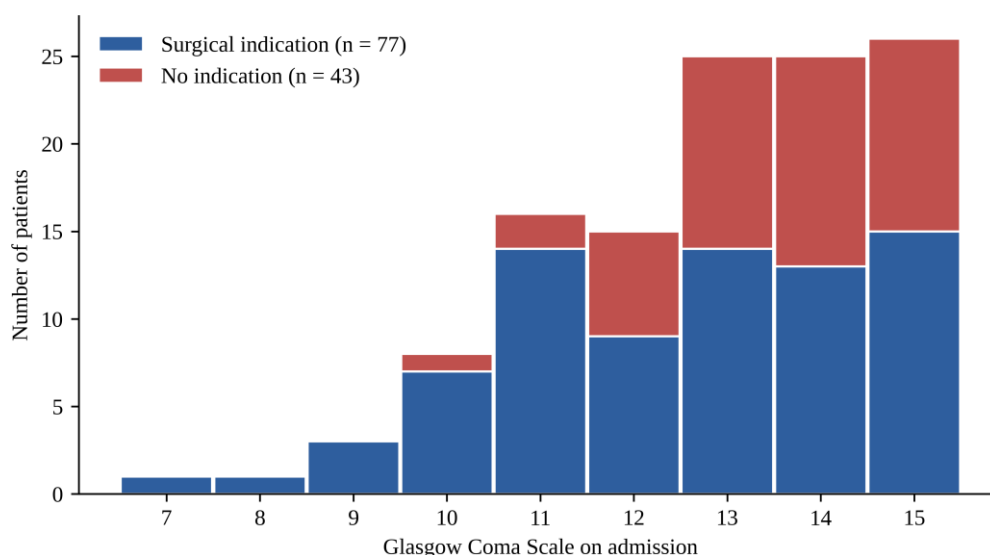


Figure 2. Distribution of the Glasgow Coma Scale score on admission according to surgical indication (n = 120).

B. Surgical Indication and Procedures

A surgical indication was recorded in 77 patients (64.2%). The operating register holds 63 procedures in 59 patients, some patients having several: evacuation/drainage of the collection (38), craniotomy with bone flap (8), decompressive craniectomy (6), debridement of an associated craniocerebral wound (9) and elevation of a depressed fracture (2). Complementary procedures answered associated lesions; they were not independent indications. Eighteen of the 77 patients with an indication (23.4%) therefore have no procedure entered in the register. We do not know the reasons, and an operation not performed cannot be distinguished from an operation not recorded. The documented-operation rate is 49.2% (59/120). Three patients were reoperated.

C. Factors Associated with the Surgical Indication: Bivariate Analysis

On bivariate analysis (Table II), the surgical indication was associated with a lower GCS, with mass effect and with greater herniation. Among patients with mass effect, 80% had an indication, against 52% without it. Age, admission delay, ILC (68.8% of patients with an indication versus 62.8% of those without; $p = 0.55$) and anisocoria were not significantly associated with the decision, before adjustment.

TABLE II. COMPARISON OF PATIENTS WITH AND WITHOUT A SURGICAL INDICATION (BIVARIATE ANALYSIS).

Factor		With indication (n = 77)	Without indication (n = 43)	p
GCS	— median [IQR]	13 [11–14]	14 [13–15]	0.010
Mass effect	— n (%)	41 (53)	10 (23)	0.002
Herniation, mm	— median [IQR]	0 [0–8]	0 [0–0]	0.003
Anisocoria	— n (%)	11 (14)	4 (9)	0.57
Initial loss of consciousness	— n (%)	53 (69)	27 (63)	0.55
Age, years	— median [IQR]	24 [16–33]	24 [19–37]	0.54
Admission delay, days	— median [IQR]	2 [1–3]	2 [1–4]	0.28

p: Mann–Whitney test (continuous variables) or Fisher’s exact test (binary variables). GCS: Glasgow Coma Scale; ILC: initial loss of consciousness.

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D. Independent Factors: Multivariable Analysis

In multivariable logistic regression (Table III, Figure 3), two factors remained independently associated with the indication. Each additional GCS point lowered the odds of an indication by about 30% (adjusted OR 0.70; 95% CI 0.53–0.92; $p = 0.010$). Mass effect multiplied these odds by 4.4 (adjusted OR 4.40; 95% CI 1.59–12.17; $p = 0.004$). Age and anisocoria were not associated with the decision. The negative, imprecise association of anisocoria, based on 15 cases, is not a protective effect: it reflects lack of power. Four of these 15 patients had no indication, which is surprising for a sign of herniation. The recorded reasons were death before theatre, family refusal, orbital trauma, and clinical improvement with a stable CT. For the first two, the decision may have been prevented rather than not taken; how to classify them remains an open question. The model shows no collinearity ($VIF < 1.5$). Its discrimination is modest (AUC 0.72; optimism-corrected AUC 0.69, with a bootstrap optimism of 0.034; Figure 4). The Hosmer–Lemeshow test reveals no lack of calibration ($\chi^2 = 8.9$; $df = 8$; $p = 0.35$), but it has low power at this sample size. A pseudo- R^2 of 0.12 shows that the model explains only a small part of the variability in the decision. Other factors, clinical or organisational, remain unmeasured or outside the model: haematoma volume and thickness, open injuries or associated fractures, non-medical constraints.

TABLE III. MULTIVARIABLE LOGISTIC REGRESSION OF FACTORS INDEPENDENTLY ASSOCIATED WITH THE SURGICAL INDICATION (N = 120; 77 INDICATIONS).

Variable	β (SE)	Adjusted OR	95% CI	p
GCS (per point)	−0.36 (0.14)	0.70	0.53–0.92	0.010
Mass effect (present)	1.48 (0.52)	4.40	1.59–12.17	0.004
Anisocoria (present)	−1.39 (0.83)	0.25	0.05–1.26	0.093
Age (per year)	−0.01 (0.02)	0.99	0.97–1.02	0.699

β : logistic coefficient; SE: standard error; OR: odds ratio; CI: confidence interval. Performance: AUC 0.72 (corrected 0.69); Hosmer–Lemeshow test $p = 0.35$; pseudo- $R^2 = 0.12$; all $VIF < 1.5$.

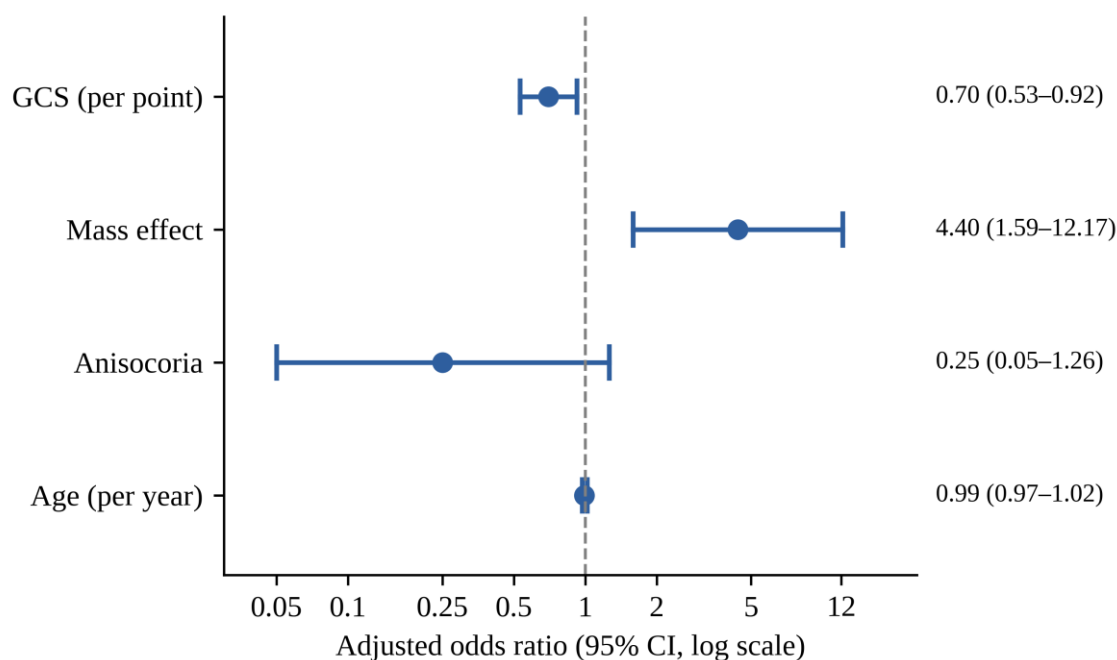


Figure 3. Forest plot of adjusted odds ratios for the factors independently associated with the surgical indication (logarithmic scale; bars: 95% CI).

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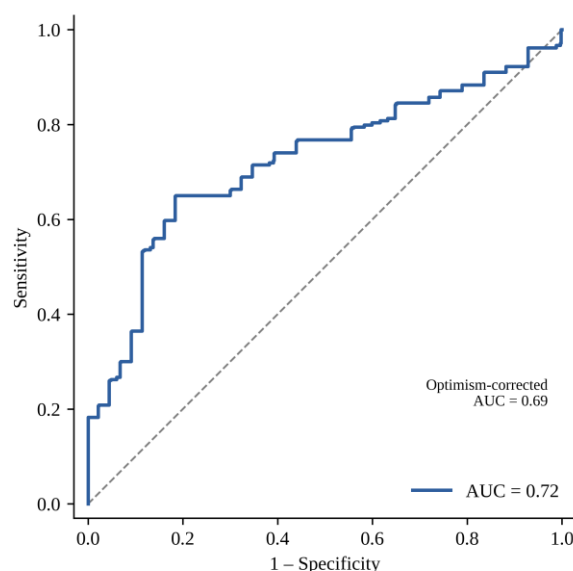


Figure 4. ROC curve of the multivariable model (apparent AUC 0.724; optimism-corrected 0.69).

In a sensitivity analysis in which herniation replaces mass effect ($n = 104$), GCS (adjusted OR 0.73; 95% CI 0.54–0.97; $p = 0.030$) and herniation (adjusted OR 1.21 per millimetre; 95% CI 1.02–1.44; $p = 0.032$) remained independently associated with the indication, in the same direction as the main model. Herniation is one of the signs that define mass effect, and its distribution is concentrated at zero (median 0 [0–0] in patients without an indication): this analysis shows concordance, not independent confirmation.

E. Outcome: Mortality and Functional Status

In-hospital mortality was low: 4 deaths (3.3%), 3 in patients with an indication and 1 in a patient without. GOS was known in 109 patients (11 missing): 104 (95.4%) had a GOS of 4 or 5 and 5 an unfavourable outcome (GOS 1–3, the 4 deaths included), at the last available assessment. If all 11 patients without a GOS had had an unfavourable outcome, the proportion with GOS 4–5 would be 86.7% (104/120). The date of the last assessment varied from patient to patient and follow-up duration could not be established reliably: this outcome is therefore a status at last news, not an outcome at a fixed time. Events being very rare, we did not model outcome; that analysis belongs to the whole TBI cohort.

IV. DISCUSSION

A. Main Finding

In this series of 120 EDH as the principal lesion, the recorded decision to operate was associated, after adjustment, with two elements: initial neurological severity (GCS) and mass effect on CT. Age and the pupillary examination did not contribute independently, and admission delay was not associated with the decision in unadjusted analysis. These two factors are unsurprising, and they partly overlap the very criteria of the indication. The value of the work lies elsewhere: most West African series describe epidemiology and outcome, whereas we modelled the decision, the clinical act of every day. That choice is warranted when mortality is too rare to model. It gives a quantified reading of how closely the decision taken follows the criteria available, to be confirmed by external validation.

B. Comparison with International and African Series

Our series resembles the Nigerian series: young men (median age 24 years, 90% male) injured on two- or three-wheelers. In Enugu, 83% of patients were men and 57% of cases were road crashes [3]. The European CENTER-TBI cohort differs: median age 41 years, 76% men [9]. Our in-hospital mortality (3.3%) is far below that of the intensive care unit of the same hospital, where head-injured patients were more severe [12]; the two series describe two different segments of the pathway.

Our indication rate (64.2%) exceeds that of Enugu (59% operated [3]) and the pooled worldwide operative rate of about 56% [4]. Our documented-operation rate (49.2%) stays below them. The 18 indications without a recorded procedure may reflect an operation not performed as well as a recording gap; our data cannot settle this. Both rates far exceed that of CENTER-TBI, where 99 of 461 patients with EDH (21%) underwent acute surgery, with notable variation between centres [9]. The comparison is delicate. In CENTER-TBI, 71% of EDH came with other intracranial haematomas, median EDH volume was 5 cm³ and volume weighed on the decision (81% of EDH of 30 cm³ or more were operated on) [9]. Our population, chosen on EDH as the principal lesion, probably gathers collections that are more often surgical. The gap therefore partly reflects different populations and

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decision thresholds. Like us, CENTER-TBI found midline shift independently associated with surgery (OR 6.63; 95% CI 1.99–22.15) [9]; mass effect also holds a central place there, with a wide interval.

C. Pathophysiological Interpretation

GCS and mass effect describe two faces of the same threat. GCS measures overall neurological impact on admission. Its fall partly reflects intracranial hypertension and weighs on the decision independently of the radiological appearance, as a marker of herniation risk.

Mass effect is its anatomical substrate: midline shift, ventricular compression and effacement of the cisterns reveal the decompensation of the collection even before its full clinical expression. It is the morphological criterion behind the classic thresholds (volume, thickness, midline shift). Its association with the decision therefore partly reflects practice following the guidelines, not a new decision factor. The absence of collinearity ($VIF < 1.5$) means that GCS and mass effect do not overlap enough to distort the estimate; it does not prove that they carry independent information, and we tested no interaction. Conversely, 36 of the 69 patients without mass effect (52%) had an indication although most injuries were mild. Collection volume, an associated fracture or wound, clinical deterioration under observation, or late admission after several days of evolution may have prompted it; our data cannot settle this.

D. The Pupillary Examination

The absence of an independent association between anisocoria and the indication calls for nuance. Anisocoria was rare (12.5%) and its estimate, imprecise, reflects lack of power, not a protective effect. Clinically, it remains a sign of herniation that demands urgency. Among the 4 anisocoric patients without an indication, the recorded reasons are death before theatre, family refusal, orbital trauma and clinical improvement with a stable CT. For at least two of them the decision was prevented rather than absent, which questions their classification in the group without an indication. The result indicates only that, among the variables retained, mass effect and GCS carry most of the association with the decision.

E. Practical Scope in a Resource-Limited Setting

These results describe one centre's practice. They are neither an algorithm nor a triage tool: with a corrected AUC of 0.69 and a pseudo- R^2 of 0.12, the model does not predict the decision and does not say what it should be. They show only that, in a resource-limited centre, where imaging and theatre are constrained and decisions are made quickly with incomplete information, GCS and mass effect, two parameters available at the bedside and on the scanner, accompany the indication most clearly among the elements we could analyse. Any generalisation requires multicentre validation and the inclusion of haematoma volume and thickness. The generally favourable outcome (mortality 3.3%; GOS 4–5 in 95.4% of evaluable patients, 86.7% in the worst case for missing data) is a reminder that an EDH that is well identified and well treated usually heals [1] [2]. It argues for early access to imaging and surgery.

F. Strengths and Limitations

Our strengths are a homogeneous population, candidate factors defined a priori, a sufficient number of events per variable, a collinearity check, a discrimination estimate corrected for optimism and a sensitivity analysis on herniation.

The limitations weigh heavily. The indication is a composite clinical decision, and several of its guideline foundations (haematoma volume and thickness, open injuries or associated fractures, location, delay in hours) are missing from the model. This partly explains the modest pseudo- R^2 and rules out presenting it as a tool. The principal lesion and mass effect rest on the same radiological notion, read by the same neurosurgeon–radiologist pair, without any measure of inter-observer reproducibility; assignment nevertheless precedes the operative decision. Our outcome is the recorded decision, not the act: 18 of the 77 patients with an indication have no documented procedure, with no reason available, and the classification of two of the four anisocoric patients without an indication (death before theatre, family refusal) is debatable. We pooled two periods (84 and 36 patients), separated by an interval without structured collection, without analysing the period effect. The study is retrospective and single-centre. Missing data (herniation 13%, GOS 9%), the varying date of the last outcome assessment and the lack of reliable follow-up duration limit its reach. Measured in days, admission delay ignores the first hours, which are decisive for lesions that need evacuating. The regression is conventional, without Firth penalised estimation, which could serve in a sensitivity analysis. Calibration was assessed only with the Hosmer–Lemeshow test, which has low power in 120 patients, without a calibration slope, and the interval for mass effect remains wide (1.59–12.17). The small number of deaths rules out any multivariable analysis of outcome. Finally, the observational design excludes any causal conclusion, and the profile described, specific to one sub-Saharan referral centre, requires external validation.

V. CONCLUSION

In this cohort, the surgical indication for extradural haematoma as the principal lesion was associated mainly with initial neurological severity and CT mass effect. The model explains only a limited part of the decision: the guidelines' major

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determinants, haematoma volume and thickness, are not in it. In-hospital mortality was low and most evaluable patients had a favourable functional outcome. Multicentre validation is needed before any generalisation.

LIST OF ABBREVIATIONS

AUC, area under the ROC curve; CI, confidence interval; CT, computed tomography; EDH, extradural haematoma; GCS, Glasgow Coma Scale; GOS, Glasgow Outcome Scale; ICMJE, International Committee of Medical Journal Editors; ILC, initial loss of consciousness; IQR, interquartile range; OR, odds ratio; RTC, road-traffic crash; STROBE, Strengthening the Reporting of Observational Studies in Epidemiology; TBI, traumatic brain injury; VIF, variance inflation factor.

AUTHOR CONTRIBUTIONS (CREDIT)

Serge Konan Yao: conceptualization, methodology, writing. Landry Stéphane Fazo Teti: conceptualization, analysis, writing, and review. Djoko Traoré: data collection and validation. Adama Simaga: data collection and resources. Koffi Jean-Jacques Kouassi: methodology, validation, and supervision. Aderehime Haidara: supervision, validation, and review. All authors approved the final version of the manuscript.

ETHICAL

The Institutional Ethics Committee of Bouaké University Hospital approved the study (no. CEI/CHU-BKE/134/2026) and granted a waiver of individual informed consent. The study follows the Declaration of Helsinki. The waiver is justified by the retrospective nature of the analysis and the exclusive use of anonymised routine-care data, which do not allow any patient to be identified.

AVAILABILITY OF DATA AND MATERIALS

The data dictionary and the analysis code are available from the corresponding author on reasonable request, in compliance with the applicable ethics regulations.

CONSENT FOR PUBLICATION

Not applicable. The manuscript contains no individual data allowing a patient to be identified; the analysis concerned anonymised routine-care data.

FUNDING

This study received no specific funding.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest concerning the publication of this article.

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