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**Radiologic Eye Deviation as a Prognostic Marker in Patients Post-Cardiac Arrest: A Retrospective Observational Study**

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## **ABSTRACT**

### **Objective**

Eye deviation is recognized as a clinical indicator of brain function in acute brain injury. This study investigated the association between radiologic eye deviations on brain computed tomography (CT) and neurological outcomes in post-cardiac arrest patients.

### **Methods**

This single-center, retrospective observational study included adult patients with out-of-hospital cardiac arrest (OHCA) of presumed medical cause who achieved return of spontaneous circulation (ROSC) and underwent brain CT within 24 hours, between January 2012 and December 2022. Radiologic lateral eye deviation angles were quantitatively measured on brain CT images. Multivariate logistic regression was conducted to identify independent predictors of poor neurological outcome at hospital discharge and in-hospital mortality. Receiver operating characteristic curve analysis evaluated diagnostic performance of eye deviation angles and serum biomarkers.

### **Results**

Among 141 patients, 127 had poor neurological outcomes. Non-conjugate eye deviation was more common in the poor outcome group (71.7% vs. 42.9%) and showed a significant association in univariate analysis (OR 3.37, 95% CI 1.10–10.90;  $p = 0.035$ ), but lost significance after multivariate adjustment. The diagnostic accuracy of the conjugate eye deviation angle was modest (AUC 0.611) and inferior to serum S-100B protein (AUC 0.790).

### **Conclusion**

Radiographic eye deviation on brain CT alone is insufficient to reliably predict neurological outcomes after cardiac arrest. Further large-scale studies incorporating multimodal approaches are needed to clarify its prognostic utility.

**Keywords:** Post-cardiac arrest syndrome, out-of-hospital cardiac arrest, eye deviation, prognostic marker

### **Capsule summary**

What is already known: Eye deviation, particularly conjugate eye deviation, is a recognized marker of brain injury and is linked to poor prognosis in conditions like stroke. It has been studied as a potential prognostic tool, but its value after cardiac arrest remains unclear.

What is new in the current study: This study is the first to specifically assess the prognostic value of radiologic eye deviation on CT in post-cardiac arrest patients. It found that, unlike in stroke, eye deviation on CT was not an independent predictor of poor neurological outcome or mortality after adjusting for other factors.

Pre-proofs

## 1. Introduction

Eye deviation is a recognized clinical marker of brain function, particularly in cases of acute brain injury [1,2]. Abnormal eye deviations, including conjugate and skew deviations, often indicate significant neurological injury, suggesting the presence of lesions in the brainstem or cerebral cortex [3,4]. In ischemic strokes, conjugate eye deviation (CED) has been associated with worse clinical outcomes, likely reflecting injury to regions involved in ocular motor control and cerebral perfusion [5]. Additionally, downward eye deviation in patients with post-resuscitation coma has been linked to progression into a vegetative state [6]. With the increasing use of brain imaging, several studies have reported that radiologic eye deviation can indicate acute cerebral infarction or large vessel occlusion and is associated with poor neurological outcomes [5,7-9].

Predicting neurological outcomes in patients post-cardiac arrest remains challenging and requires a multimodal approach. Various clinical examinations and modalities have been explored for prognostication, including pupillary light reflex, somatosensory evoked potentials (SSEP), and serum markers such as neuron-specific enolase (NSE) [10,11].

The gray-to-white matter ratio on brain computed tomography (CT), is also a key imaging-based prognostic tool. Eye deviation, which can be measured on the same CT scans, may offer an additional, accessible marker of neurologic outcome. The potential role of radiologic eye deviation in predicting poor neurological outcomes, such as cerebral performance category (CPC) scores of 3–5, warrants further investigation as it could serve as a simple and accessible marker for use in clinical practice.

This study investigated the association between conjugate eye deviation on brain CT following cardiac arrest and neurological outcomes, particularly poor neurological outcome (CPC 3–5). By evaluating radiologic eye deviation in this context, the study sought to determine its prognostic value and contribute to the growing body of evidence supporting the use of ocular findings in neuroprognostication. A clearer understanding of this relationship may support early decision-making in the management of comatose post-cardiac arrest patients.

## 2. Methods

### *2.1. Ethics Statement*

The study was approved by the Institutional Review Board of XXX Hospital on March 18, 2024 (IRB No. 2403-009-19514). The requirement for informed consent was waived due to the retrospective study design.

### *2.2. Study Design and Population*

This single-center, retrospective observational study included adult patients evaluated in the emergency department after out-of-hospital cardiac arrest (OHCA) between January 2012 and December 2022. The study was conducted at a 30-bed facility with a 24-hour emergency department staffed by board-certified emergency physicians. Resuscitated patients were admitted to the intensive care unit for advanced care. Patients were included if they were 18 years or older, experienced an out-of-hospital cardiac arrest of presumed medical etiology, achieved return of spontaneous circulation (ROSC) in the emergency department, and underwent a brain CT scan within 24 hours after ROSC. Exclusion criteria comprised death before the ED disposition, transfer to another facility, early recovery of consciousness in the emergency department, diagnosis of acute ischemic or hemorrhagic stroke, and history of eye surgery.

### *2.3. Data Collection and Outcome Measurement*

Data were retrieved from participants' electronic medical records of the study participants and included demographic information (age and sex), comorbidities (hypertension, diabetes mellitus, heart disease, respiratory disease, liver disease, chronic kidney disease, stroke, and cancer), electrocardiogram rhythm, cause of cardiac arrest, duration of cardiopulmonary resuscitation (CPR), use of targeted temperature management (TTM), levels of S-100B protein and NSE measured immediately after ROSC, and radiologic findings on brain CT. Serum concentrations of S-100B protein and NSE were measured using electrochemiluminescence immunoassay (ECLIA) (Roche Diagnostics, Mannheim, Germany) according to the manufacturer's instructions. Radiologic findings included the presence of conjugate eye deviation, the angle and direction of deviation in each eye, and the presence

of hypoxic brain injury. Hypoxic brain injury was qualitatively assessed by board-certified radiologists based on recognized imaging features reported in their official readings.

The primary outcome was poor neurological outcome, defined as a CPC score of 3–5 at hospital discharge. The secondary outcome was in-hospital mortality.

#### *2.4. Radiologic Lateral Eye Deviation*

Radiologic lateral eye deviation was assessed using CT imaging (Brilliance iCT 256, Philips Healthcare, The Netherlands), performed with a 5-mm slice thickness through the orbit. Patients who were post-resuscitation underwent CT within 24 hours of ROSC. Deviation angles were calculated using three reference lines as previously described [12]. The first line (Line A) was aligned with the nasal midline, the second line (Line B) was drawn perpendicular to the Line A, and Lines C and D extended along the horizontal axis of each lens (Fig. 1). Deviation angles were measured separately for each orbit.

The radiologic conjugate eye deviation was defined as deviation of both eyes in the same direction, regardless of the absolute angle. The CED mean angle was calculated as the mean deviation of the right and left eyes. The CED angle difference was absolute difference between the deviation angles of the right and left eyes. Radiologic eye deviation was independently assessed by two authors, J.H.K. and C.A. In cases where their assessments differed, a consensus was reached through discussion with coauthor Y.T. Oh.

#### *2.5. Statistical Analysis*

Descriptive statistical analysis was performed to determine baseline characteristics. Categorical variables were analyzed using Pearson's chi-square and Fisher's exact tests. Continuous variables were analyzed using an independent samples t-test for parametric data and the Mann–Whitney U test for non-parametric data. The Shapiro–Wilk test was used to assess data normality. To identify independent predictors of clinical outcomes, we performed multivariate logistic regression analysis. Initially, we included covariates reported to be clinically relevant or associated with outcomes in previous studies,

including age, sex, shockable EKG rhythm, cause of cardiac arrest, duration of CPR, use of TTM, presence of non-conjugate eye deviation, and hypoxic injury on brain CT. The final model was refined using a stepwise backward elimination method, in which variables with the highest p-values (typically  $>0.05$ ) were sequentially removed until only statistically significant predictors remained. Given the substantial missing data for S-100B protein and NSE (62.4% and 29.8% missing, respectively), these biomarkers were excluded from the multivariable logistic regression to maintain model stability and avoid a significant reduction in sample size. Receiver operating characteristic (ROC) curves were constructed to determine optimal cut-off values for serum S-100B protein, NSE, and conjugate deviation angle in predicting poor neurologic outcomes in patients. All statistical analyses were performed using R (version 4.4.2, The R Foundation for Statistical Computing, Vienna, Austria), with statistical significance set at  $p < 0.05$ .

### 3. Results

We identified 1,843 patients who had experienced OHCA. After excluding 1,603 patients due to the absence of brain imaging, non-medical causes, missing data, age under 18 years, or delayed imaging, 240 patients remained for eligibility assessment. Further exclusions were made for lack of return of spontaneous circulation (ROSC), transfer to another facility, early recovery of consciousness, hemorrhagic stroke, history of eye surgery, or ischemic stroke. Ultimately, 141 patients were included in the study (Fig. 2).

#### 3.1. Baseline Characteristics

Of the 141 patients, 127 patients had poor neurologic outcomes and 14 had good neurologic outcomes (Table 1). The poor neurologic outcome group had significantly higher mean age (67.1 vs. 55.9 years,  $p = 0.008$ ), longer CPR duration (26.9 vs. 9.2 minutes,  $p < 0.001$ ), and extended ROSC to CT time ( $94.2 \pm 133.0$  vs.  $56.4 \pm 45.9$  minutes,  $p = 0.031$ ) compared to the good outcome group. Non-conjugate eye deviation was more prevalent in the poor outcome group (71.7%) than in the good outcome group (42.9%), approaching but not reaching statistical significance ( $p = 0.057$ ). Conversely, conjugate eye

deviation was more frequent in the good outcome group (57.1%) than in the poor outcome group (28.3%).

There were no significant group differences in the direction of conjugate deviation (right vs. left), mean angle, or angle asymmetry. Hypoxic injury on CT was significantly more common in the poor outcome group (40.2% vs. 7.1%,  $p = 0.033$ ). Serum S-100B protein levels were significantly higher in the poor outcome group than in the good outcome group, with medians of 4.4 [2.4; 8.0] ng/ml vs. 2.5 [1.3; 2.8] ng/ml ( $p = 0.019$ ). NSE levels did not differ significantly, showing medians of 35.0 [23.2; 46.3] ng/ml vs. 33.5 [27.9; 40.0] ng/ml ( $p = 0.760$ ).

### *3.2. Crude and Adjusted Odds Ratios of Conjugate Eye Deviation for Neurologic Outcomes*

Univariate analysis showed that non-conjugate eye deviation was significantly associated with poor neurologic outcome (OR 3.37, 95% CI 1.10–10.90;  $p = 0.035$ ; Table 2). However, in the multivariate model, this association was not independent. Instead, only older age (adjusted OR 1.05, 95% CI 1.00–1.11;  $p = 0.05$ ) and longer CPR duration (adjusted OR 1.29, 95% CI 1.16–1.50;  $p < 0.001$ ) remained significant predictors.

### *3.3. Crude and Adjusted Odds Ratios of Conjugate Eye Deviation for Mortality*

In univariate analysis, non-conjugate eye deviation was not significantly associated with in-hospital mortality (OR 1.71, 95% CI 0.81–3.59;  $p = 0.160$ ; Table 3). In the multivariate analysis, only CPR duration remained a significant independent predictor of mortality (adjusted OR 1.11, 95% CI 1.06–1.16;  $p < 0.001$ ; Table 3).

### *3.4. Diagnostic Performance of CED Angle, NSE, and S-100B Protein for Predicting Neurological Outcomes*

The optimal cut-off value for the CED angle was 6°, yielding a sensitivity of 77.78%, specificity of 62.5%, positive predictive value (PPV) of 90.32%, negative predictive value (NPV) of 38.46%, and an area under the curve (AUC) of 0.611 (Table 4) (Fig. 3). The NSE cut-off value was 42.9, with an AUC

of 0.542. S-100B protein had the highest diagnostic performance, with a cut-off value of 3.2 and an AUC of 0.790.

#### **4. Discussion**

This is the first study to examine the relationship between radiologic eye deviation and clinical outcomes in resuscitated patients. While prior studies have suggested that eye deviation can serve as a prognostic marker in acute brain injuries, particularly for stroke, its clinical utility in post-cardiac arrest patients has not been well established. In our study, non-conjugate eye deviation was significantly associated with poor neurological outcomes in univariate analysis. However, this association did not remain significant after multivariable adjustment. The mortality rate showed the same pattern. Similarly, neither the direction nor the angle of conjugate eye deviation was independently associated with neurological outcomes or in-hospital mortality.

These findings contrast with previous research in stroke populations, where conjugate eye deviation has been linked to more extensive brain injury and worse clinical outcomes. In stroke, damage to cortical and subcortical regions involved in gaze control disrupts ocular motor pathways, resulting in fixed gaze and impaired neurologic function. In resuscitated patients, however, eye deviations are presumed to result from diffuse hypoxic-ischemic brain injury. The lack of association between eye deviation and prognosis suggests that brain injury after cardiac arrest may affect ocular motor pathways in a more generalized or variable manner [13-16]. It is also possible that eye deviation in this population is transient or affected by heterogeneous pathophysiological mechanisms.

In our study, the diagnostic performance of the conjugate eye deviation angle was modest (cut-off 6°, AUC 0.611), whereas S-100B protein (AUC 0.790) and NSE (AUC 0.542) exhibited relatively higher diagnostic performance in ROC analysis. However, the clinical utility of these biomarkers is constrained by substantial missing data. Thus, despite showing potential in ROC analysis, the prognostic application of these biomarkers requires careful consideration of data completeness in real-world clinical practice.

This study has the nature of a pilot study to explore the relationship between conjugate eye deviation and the neurological prognosis of patients after cardiac arrest. Unfortunately, the results of this study

did not establish the clinical usefulness of conjugate eye deviation use in patients after cardiac arrest. Nevertheless, the potential for radiologic markers in neuroprognostication remains promising. Brain CT is rapid, widely available, and capable of detecting subtle findings. With the emergence of artificial intelligence tools, automated, reproducible measurements may reduce observer variability and improve prognostic accuracy. Given the absence of a single gold standard for neurological outcome prediction post-cardiac arrest, a multimodal approach that combines integrating imaging findings like conjugate eye deviation with biomarkers such as NSE and S-100B protein could enhance prognostic frameworks in the future.

Our analysis was limited to horizontal eye deviation due to CT protocol constraints. While a study has reported vertical eye deviations (e.g., upward or downward gaze) in post-resuscitation coma [6], our study primarily examined the relationship between left and right eye deviation and prognosis using CT. This may oversimplify the relationship between eye deviation and neurological outcomes. In contrast to ischemic stroke, where focal lesions align with ocular findings, the diffuse nature of hypoxic brain injury may lead to a more complex and variable ocular response. Further studies should explore vertical and other deviation types in this patient group.

In this study, the time from ROSC to brain CT showed a statistically significant difference according to neurological outcomes. The timing of CT was determined at the clinician's discretion. Although current resuscitation guidelines recommend brain CT acquisition within 24 hours after ROSC, previous studies have reported that early CT performed within 1–2 hours can detect severe brain injury [10,11,17]. The CT acquisition times in both outcome groups were therefore considered adequate to reflect brain injury caused by cardiac arrest. Unlike acute stroke patients, where imaging timing may directly affect treatment decisions, the timing of brain imaging in our cohort was unlikely to influence clinical management significantly. Thus, differences in ROSC-to-CT timing are unlikely to be a major confounder in interpreting neurological outcomes in this study.

This study has some limitations. First, its retrospective design may have introduced selection bias, potentially limiting the generalizability of the findings. A substantial number of patients who achieved

ROSC were excluded because they did not undergo brain CT, as the decision for imaging was at the treating physician's discretion. This likely contributed to the low proportion of patients with good neurological outcomes (9.9%, 14/141) in our cohort, suggesting that the patient selection may not fully represent the broader population spectrum. Future studies should implement standardized brain imaging protocols after ROSC to ensure more representative patient cohorts. Second, the single-center setting and small sample size may not have captured the full spectrum of outcomes or variability in eye deviation patterns. Third, unmeasured confounders, such as bystander CPR or prehospital care, were not accounted for and may have influenced outcomes [18]. Fourth, because most post-cardiac arrest patients are unresponsive, we assessed eye deviation using CT rather than neurological examination. While CT is practical in this setting, it cannot assess voluntary eye movement, which limits its ability to fully evaluate ocular function. Finally, the observational nature of the study prevents causal inference.

In summary, this study was the first to explore the potential prognostic value of radiographic eye deviation in patients resuscitated after cardiac arrest. While non-conjugate eye deviation initially correlated with poor neurological outcomes, this was not maintained after adjusting for confounding factors. Neither conjugate deviation angle nor direction independently predicted neurological outcomes or mortality. These findings suggest that eye deviation on CT lacks standalone prognostic utility in this population, likely due to the multifactorial and diffuse nature of hypoxic brain injury. Future research should focus on larger multimodal studies using advanced imaging techniques for improved neuroprognostication.

### **Ethical statements**

The study protocol was approved by the Institutional Review Board of Chung-Ang University Hospital on March 18, 2024 (IRB No. 2403-009-19514). The requirement for informed consent was waived due to the study's retrospective design.

### **Conflict of interest statement**

The authors declare no conflicts of interest.

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### **Author contributions**

Conceptualization: C.A.; Data curation: J.H.K.; Formal analysis: J.H.K.; Investigation: C.A. and J.H.K.; Methodology: C.A. and J.H.K.; Project administration: C.A.; Resources: All authors; Software: C.A. and Y.T.O.; Supervision: C.A.; Validation: Y.T.O.; Visualization: Y.T.O.; Writing—, original draft: C.A. and J.H.K.; Writing—, review, and editing: C.A. and Y.T.O. All authors have read and approved the final manuscript.

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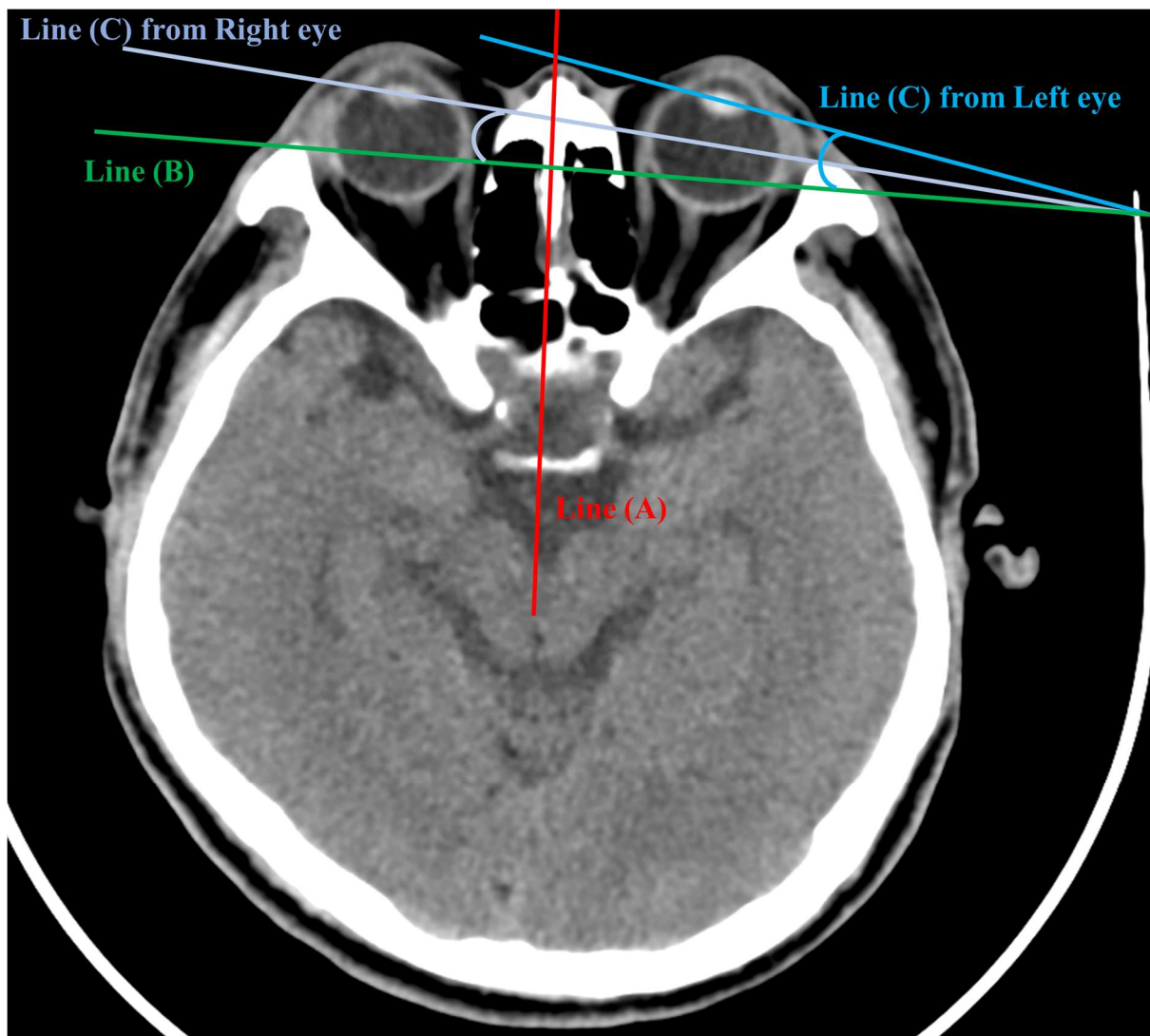
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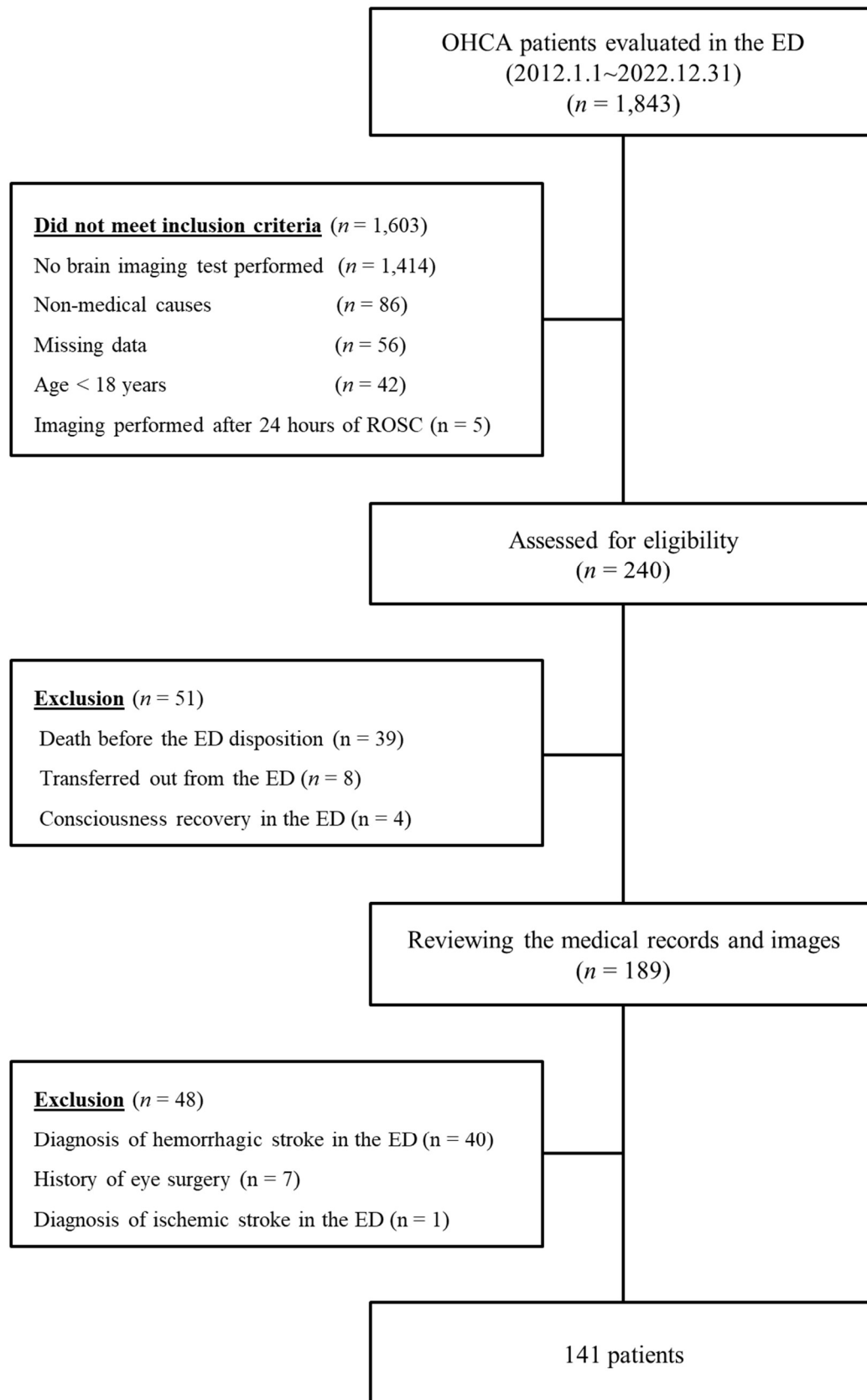
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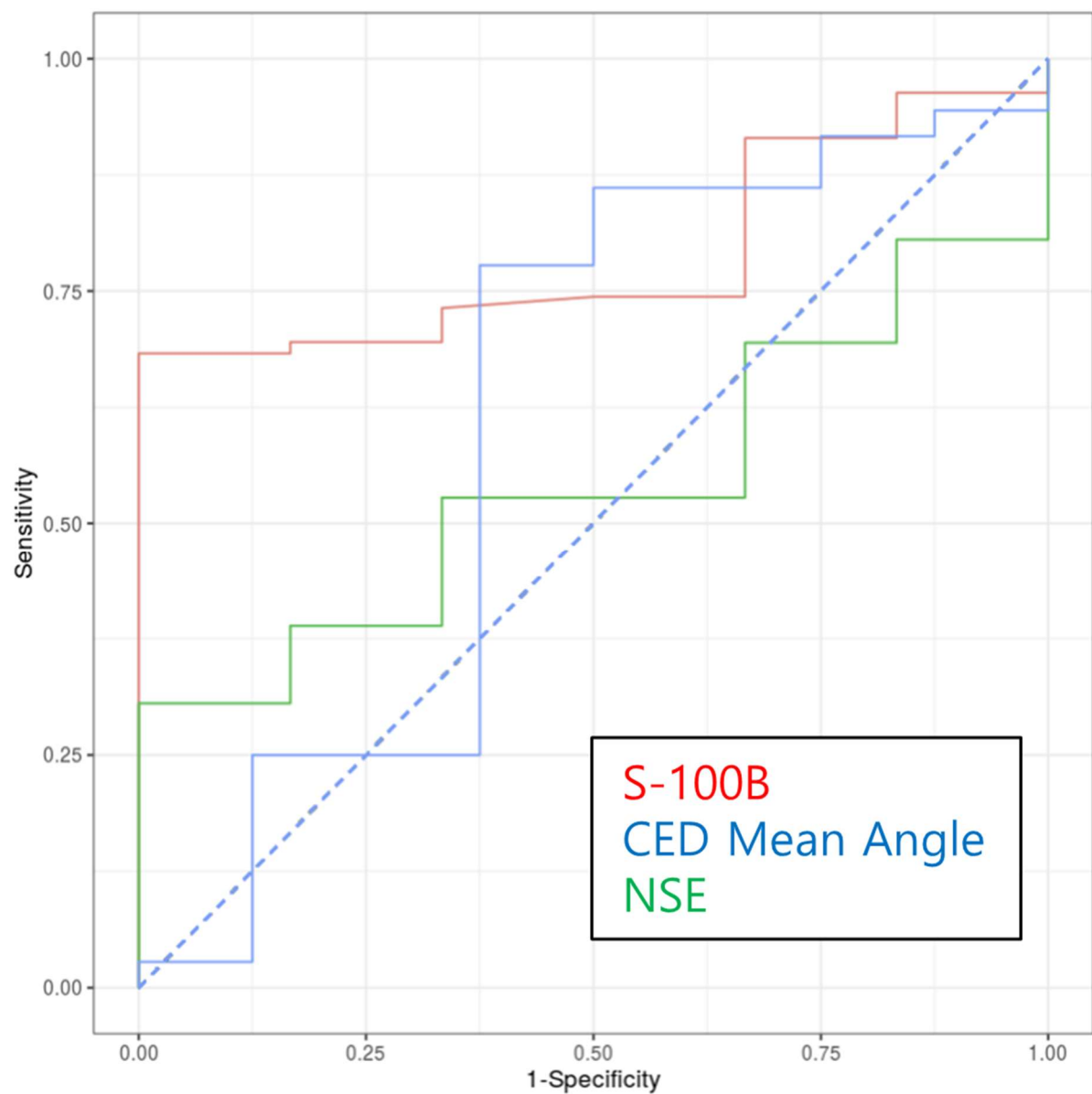


**Figure 1.** Computed tomography (CT) imaging methodology for measuring radiologic eye deviation.



**Figure 2.** Flow chart of population selection.

Pre-proofs



**Figure 3.** Receiver operating characteristic (ROC) curves for CED angle, NSE, and S-100B protein for neurological outcome prediction.

**Table 1.** Baseline characteristics.

| Variables                     | Poor neurologic    | Good neurologic   | <i>p</i> -value |
|-------------------------------|--------------------|-------------------|-----------------|
|                               | outcome<br>(n=127) | outcome<br>(n=14) |                 |
| Age (years)                   | 67.1 ± 14.5        | 55.9 ± 17.9       | 0.008           |
| Sex, male                     | 92 (72.4%)         | 9 (64.3%)         | 0.741           |
| Underlying disease            |                    |                   |                 |
| Hypertension                  | 63 (49.6%)         | 8 (57.1%)         | 0.800           |
| Diabetes mellitus             | 45 (35.4%)         | 4 (28.6%)         | 0.829           |
| Heart disease                 | 38 (29.9%)         | 6 (42.9%)         | 0.492           |
| Respiratory disease           | 11 (8.7%)          | 2 (14.3%)         | 0.839           |
| Liver disease                 | 2 (1.6%)           | 0 (0.0%)          | 1.000           |
| Renal disease                 | 19 (15.0%)         | 1 (7.1%)          | 0.695           |
| Stroke                        | 13 (10.2%)         | 0 (0.0%)          | 0.441           |
| Cancer                        | 12 (9.4%)          | 2 (14.3%)         | 0.918           |
| Shockable EKG rhythm          | 14 (11.0%)         | 3 (21.4%)         | 0.483           |
| Ventricular fibrillation      | 12 (9.4%)          | 3 (21.4%)         | 0.339           |
| Pulseless VT                  | 2 (1.6%)           | 0 (0.0%)          |                 |
| Pulseless electrical activity | 41 (32.3%)         | 6 (42.9%)         |                 |
| Asystole                      | 72 (56.7%)         | 5 (35.7%)         |                 |
| Cardiac origin                | 32 (25.2%)         | 6 (42.9%)         | 0.273           |
| CPR time (min)                | 26.9 ± 16.2        | 9.2 ± 5.7         | < 0.001         |
| TTM                           | 70 (55.1%)         | 9 (64.3%)         | 0.710           |
| ROSC to CT time (min)         | 94.2 ± 133.0       | 56.4 ± 45.9       | 0.031           |
| Non-conjugate eye deviation   | 91 (71.7%)         | 6 (42.9%)         | 0.057           |
| Conjugate eye deviation       | 36 (28.3%)         | 8 (57.1%)         |                 |
| Right                         | 16 (55.6%)         | 4 (50.0%)         | 1.000           |
| Left                          | 20 (44.4%)         | 4 (50.0%)         |                 |
| Mean angle (°)                | 8.5 ± 4.3          | 8.0 ± 5.5         | 0.788           |

|                                |                  |                  |       |
|--------------------------------|------------------|------------------|-------|
| Angle difference (°)           | 6.8 ± 5.3        | 4.8 ± 3.7        | 0.334 |
| Hypoxic injury on CT finding   | 51 (40.2%)       | 1 (7.1%)         | 0.033 |
| S-100B protein (ng/ml), (n=88) | 82 (64.6%)       | 6 (42.9%)        | 0.193 |
|                                | 4.4 [2.4; 8.0]   | 2.5 [1.3; 2.8]   | 0.019 |
| NSE (ng/ml), (n=42)            | 36 (28.3%)       | 6 (42.9%)        | 0.413 |
|                                | 35.0 [23.2;46.3] | 33.5 [27.9;40.0] | 0.760 |

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Values are shown as the mean ± standard deviation, median [interquartile range], or frequency (proportion). EKG, electrocardiogram; VT, ventricular tachycardia; CPR, cardiopulmonary resuscitation; TTM, targeted temperature management; ROSC, return of spontaneous circulation; CT, computed tomography; NSE, neuron-specific enolase.

**Table 2.** Crude odds ratio and adjusted odds ratio of conjugate eye deviation on brain computed tomography (CT) for poor neurologic outcomes in post-resuscitated patients.

| <b>Factor</b>                | <b>Univariate OR<br/>(95% CI)</b> | <b><i>p</i>-value</b> | <b>Adjusted OR<br/>(95% CI)</b> | <b><i>p</i>-value</b> |
|------------------------------|-----------------------------------|-----------------------|---------------------------------|-----------------------|
| Age (years)                  | 1.05 (1.01-1.08)                  | 0.012                 | 1.05 (1.00-1.11)*               | 0.05                  |
| Sex, male                    | 1.46 (0.42-454)                   | 0.522                 | -                               | -                     |
| Shockable EKG rhythm         | 0.45 (0.12-2.18)                  | 0.267                 | -                               | -                     |
| Cardiac origin               | 0.45 (0.15-1.46)                  | 0.166                 | 0.27 (0.05-1.36)*               | 0.118                 |
| CPR time (min)               | 1.29 (1.16-1.47)                  | < 0.001               | 1.29 (1.16-1.50)*               | < 0.001               |
| TTM                          | 0.68 (0.20-2.09)                  | 0.514                 | -                               | -                     |
| Non-conjugate eye deviation  | 3.37 (1.10-10.90)                 | 0.035                 | -                               | -                     |
| Hypoxic injury on CT finding | 8.72 (1.66-160.92)                | 0.040                 | -                               | -                     |

Adjusted for age, sex, shockable EKG rhythm, cause of arrest, duration of CPR, TTM, Conjugate eye deviation, and Brain CT finding. \* Factors included in the final logistic regression model for survival to discharge. Variables not included in the final stepwise multivariable model are indicated by dash. OR, odds ratio; CI, confidence interval; EKG, electrocardiogram; CPR, cardiopulmonary resuscitation; TTM, targeted temperature management; CT, computed tomography.

**Table 3.** Crude odds ratio and adjusted odds ratio of conjugate eye deviation on brain computed tomography (CT) for mortality in post-resuscitated patients.

| Factor                       | Univariate OR<br>(95% CI) | p-value | Adjusted OR<br>(95% CI) | p-value |
|------------------------------|---------------------------|---------|-------------------------|---------|
| Age (years)                  | 1.02 (1.00-1.05)          | 0.056   | 1.02 (0.99-1.05) *      | 0.163   |
| Sex, male                    | 1.35 (0.62-2.90)          | 0.438   | -                       | -       |
| Shockable EKG rhythm         | 0.66 (0.23-1.92)          | 0.425   | -                       | -       |
| Cardiac origin               | 0.77 (0.36-1.71)          | 0.517   | -                       | -       |
| CPR time (min)               | 1.11 (1.06-1.16)          | < 0.001 | 1.11 (1.06-1.16) *      | < 0.001 |
| TTM                          | 0.65 (0.31-1.33)          | 0.244   | -                       | -       |
| Non-conjugate eye deviation  | 1.71 (0.81-3.59)          | 0.160   | -                       | -       |
| Hypoxic injury on CT finding | 0.87 (0.42-1.81)          | 0.700   | -                       | -       |

Adjusted for age, sex, shockable EKG rhythm, cause of arrest, duration of CPR, TTM, Conjugate eye deviation, and Brain CT finding. \* Factors included in the final logistic regression model for survival to discharge. Variables not included in the final stepwise multivariable model are indicated by dash. OR, odds ratio; CI, confidence interval; EKG, electrocardiogram; CPR, cardiopulmonary resuscitation; TTM, targeted temperature management; CT, computed tomography.

**Table 4.** Performance of conjugate eye deviation angle, neuron-specific enolase levels, and S-100B protein for predicting neurological outcomes.

|                | <b>Cut-off</b><br>(°) | <b>Sensitivity</b><br>(%) | <b>Specificity</b><br>(%) | <b>PPV</b><br>(%) | <b>NPV</b><br>(%) | <b>AUC</b> |
|----------------|-----------------------|---------------------------|---------------------------|-------------------|-------------------|------------|
| CED angle (°)  | 6.0                   | 77.78%                    | 62.5%                     | 90.32%            | 38.46%            | 0.611      |
| NSE (ng/ml)    | 42.9                  | 30.56 %                   | 100%                      | 100%              | 19.35%            | 0.542      |
| S-100B (ng/ml) | 3.2                   | 68.29%                    | 100%                      | 100%              | 18.75%            | 0.790      |

PPV, positive predictive value; NPV, negative predictive value; AUC, area under curve; CED, conjugate eye deviation; NSE, neuron-specific enolase.