Validation of a score in the prehospital setting for detecting intracranial lesions in unconscious patients

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ABSTRACT

Prehospital recognition of stroke and other intracranial disorders allows for faster recanalization and other specialized therapy. In patients with a low degree of consciousness, recognizing these can be challenging. To identify patients with intracranial disease, we previously developed a scoring system that combined systolic blood pressure, age, and heart rate. The goal of this study was to confirm the score in a bigger, distinct group.

Materials and procedures: We performed a registry-based retrospective analysis on 16-year-old patients with a Glasgow Coma Score of 15 who were treated by helicopter emergency medical services. Patients' diagnoses at the end of their hospital stay were utilised to determine whether or not they had an intracranial lesion. The area under the receiver operating characteristic curve was used to measure the performance of the score (AUROC).

Key word: *Patients; Intracranial lesions*

LETTER

A total of 1,925 (20.7 percent) of the 9,309 patients included in the study had an intracranial lesion, including 1,211 cases of stroke. An intracranial lesion was predicted by older age, higher blood pressure, and a lower heart rate (all P0.001). With an AUROC of 0.749, the score discriminated patients with intracranial lesions (95% CI 0.737 to 0.761). Only patients admitted in the prehospital period were included, with an AUROC of 0.780 (95% CI 0.770 to 0.806) or convulsion-related diagnosis excluded, with an AUROC of 0.788 (95%CI 0.768 to 0.792).

In prehospital treatment, systolic blood pressure, heart rate, and age are used to differentiate brain lesions in patients with a diminished state of awareness. This could make it easier to get to a stroke centre quickly and apply neuroprotective therapies in prehospital critical care.

Intoxication, hypoglycemia, stroke, seizure, or trauma are all common causes of impaired level of consciousness, which can be caused by a variety of medical or surgical diseases, including intoxication, hypoglycemia, stroke, seizure, or trauma.

While some of these illnesses can be recognized and treated by EMS professionals in the prehospital setting, effective diagnosis of others, particularly cerebral lesions, usually necessitates advanced in-hospital investigations, such as computer tomography. Intracranial lesions, on the other hand, should be recognized as soon as feasible to avoid delays in getting to a tertiary-care facility with recanalization and neurosurgery skills.

Controlled breathing and oxygenation are frequently required in patients with a cerebral lesion as the reason of reduced level of awareness.

Mobile Stroke Units (MSU) and biomarkers for bedside testing have been proposed to speed up the recognition of intracranial lesions in the prehospital setting, but none of them are widely available, and costs may limit their widespread use in the future, particularly in low- and middle-income countries and rural areas. There are a number of validated scoring systems for detecting ischemic stroke. These scores are based on neurological signs that may be difficult to detect in a patient with a low degree of consciousness. We previously described a new scoring tool that combines heart rate, systolic blood pressure, and age to recognize intracranial lesions among patients with impaired level of consciousness to overcome the challenge of early recognition of an intracranial lesion as a cause of impaired level of consciousness.

The goal of this study was to test the scoring tool on a bigger group of people. On reasonable request, the corresponding author will provide the data that support the conclusions of this study. We compared the first prehospital systolic blood pressure, heart rate, and age of patients with and without cerebral lesion in a retrospective Case-Control study.

The study was based on a registry and had no bearing on the patients' therapy. The study protocol (HUS/3115/2019 194) was accepted by the Helsinki University Hospital Ethical Committee. Transparent reporting of a multivariable prediction model for individual prognosis or diagnosis statement was used to report the study.

We looked at data from the national quality database for Helicopter Emergency Medical Services (HEMS). HEMS services in Finland are coordinated, owned, and funded by the government. The national emergency response centre dispatches HEMS units based on predetermined criteria for critically ill or injured patients. These are deployed in addition to ground ambulances to offer prehospital critical care and carry out basically only one primary duty. When hypoglycemia is not detected, the dispatching criteria include unconsciousness of unknown origin.

Physicians staff five of the six HEMS units. When a patient is known to be aware, they are not dispatched to a suspected stroke. The HEMS unit that serves the country's most sparsely populated northern regions is not staffed with doctors and is dispatched to awaken stroke patients so that they can be transported to the hospital quickly.

The National Hospital Discharge Registry (HILMO) is maintained by the Finnish Institute for Health and Welfare, where data on the activities of all health centers, hospitals, and other institutions providing inpatient treatment is submitted, omitting data from HEMS services. Data may be traced and contains information about admission and discharge, as well as delivered treatment and diagnosis. The collecting of data for this registration is required by Finnish law. The HEMS mission data was linked to admission and discharge data using a personal identity code. The time between the arrival of the HEMS unit and the subsequent admittance to the hospital was set at 24 hours.

Patients aged 16 or older with a Glasgow Coma Scale (GCS) score of 15 who were seen by any HEMS unit in Finland between January 2012 and September 2019 were included in the study. The population from the previous score conducting study20 was not included in this study. Because of the natural age-dependent change in blood pressure, patients under the age of 16 were eliminated. Patients with a lowered level of awareness due to out-of-hospital cardiac arrest or evident trauma, as well as patients, whose diagnosis was not determined at the time of discharge, such as due to a missing personal identification number, were removed.

Following exclusions, participants who remained in the trial were divided

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into two groups based on their final diagnosis at the end of their stay: 1) those who have had an intracranial lesion 2) Patients who do not have an intracranial lesion Intracranial lesions were described as ischemic or hemorrhaging stroke and non-traumatic intracranial bleeding in the International Statistical Classification of Diseases and Related Health Problems (ICD-10). In online supplement 1, a full list of diagnosing codes is supplied. Diagnosis upon discharge was obtained from HILMO, a database where it is submitted by the respective hospital.

During the study period, HEMS encountered 36,715 patients, 9,309 of whom met the inclusion criteria and were therefore included in the study. An intracranial lesion was found in 1,925 (20.7%) of the patients. 1,211 (63%) of the patients had a stroke, with 509 being ischemic (ICD-10 category I63), 533 being intracerebral hemorrhage (I61), 162 being subarachnoid hemorrhage (I60), and seven being neither ischemic nor hemorrhagic (I64). The rest of the intracranial lesions included various types of traumatic and non-traumatic bleeding, neoplasms, central nervous system infections, and so on.

Higher systolic blood pressure, lower heart rates, and older age were all found in patients with an intracranial lesion. In distinguishing patients with and without a lesion, the score showed an AUROC of 0.749 (95 percent CI 0.737 to 0.761). The score performed somewhat better in the subgroup of patients intubated during prehospital treatment (AUROC 0.780, 95 percent CI 0.770 to 0.806) or when patients with convulsions were eliminated (AUROC 0.780, 95 percent CI 0.770 to 0.806). (AUROC 0.788, 95 percent CI 0.768 to 0.792).

Patient distribution and score attributes at various cut-offs. The final regression analysis with the scoring tool contained 8554 patients due to missing values of systolic blood pressure and/or heart rate.

The accuracy of the score was slightly enhanced after recalibrating it. The AUROC was 0.761 after changing the points provided for age 50-70 and over 70 to two and three, respectively, as well as two and four points for systolic blood pressures of 140-170 and above 170 mmHg (95 percent CI 0.749 to 0.773). Online supplements 2 and 3 detail recalibration and patient distribution, respectively.

Our findings show that a grading method based on systolic blood pressure, heart rate, and age can be used with moderate accuracy in the prehospital situation to identify patients whose decreased level of awareness is caused by an intracranial lesion, most commonly a stroke. To our knowledge, this is the first validated scoring technique for predicting intracranial lesions in a prehospital setting that does not rely on neurological signs and does not require patient cooperation. While recalibrating the score enhanced accuracy slightly, the point distribution became less feasible from a clinical standpoint; hence the old point distribution was retained.

There are some limitations to the current study that must be noted when applying the findings. To begin, in Finland's HEMS system, physicians assess whether the patient benefits from HEMS participation and cancel or deny a huge percentage of missions. There were no uniform guidelines in place during the study period.

Patients should be attended to, which adds to the selection bias. Second, because the data is not independently checked, there is a risk of recording inaccuracies. However, they are most likely dispersed randomly and are unlikely to generate major bias. Third, in-hospital diagnostic methods were not regulated, and patients did not receive routine head imaging, for example. Because diagnoses were obtained near the end of the hospitalization, it's probable that some intracranial abnormalities went unnoticed. However, because nearly all of the receiving hospitals have convenient access to computed tomography, we believe that undetected lesions causing a loss of consciousness are uncommon.

The study, on the other hand, has a number of advantages.

In the country, there is only one HEMS that serves practically the whole population. In addition, all missions are prospectively logged into a standardized database with minimal missing data. Furthermore, the public hospital system and national registries make it possible to collect data with minimal gaps. All of these elements make it easier to create reliable datasets for research purposes.

When level of consciousness is reduced in the prehospital situation, a score incorporating systolic blood pressure, heart rate, and age may help identify individuals with an intracranial lesion. This can be used to identify individuals who should be sent to a tertiary neurologic center right away and who might benefit from a neuroprotective approach in prehospital critical care.