

## MaineHealth MaineHealth Knowledge Connection

---

Maine Medical Center

All MaineHealth

---

5-1-2019

# Neurocardiac risk stratification 6 hours after resuscitation from cardiac arrest

A Bilkanovic

Z Haxhija

L Lucas

*Maine Medical Center*

J Dziodzio

*Maine Medical Center*

R R. Riker

*Maine Medical Center*

*See next page for additional authors*

Follow this and additional works at: <https://knowledgeconnection.mainehealth.org/mmc>



Part of the [Cardiology Commons](#), and the [Pulmonology Commons](#)

---

### Recommended Citation

Bilkanovic, A; Haxhija, Z; Lucas, L; Dziodzio, J; Riker, R R.; May, T; Friberg, H; and Seder, D B., "Neurocardiac risk stratification 6 hours after resuscitation from cardiac arrest" (2019). *Maine Medical Center*. 682.

<https://knowledgeconnection.mainehealth.org/mmc/682>

This Poster is brought to you for free and open access by the All MaineHealth at MaineHealth Knowledge Connection. It has been accepted for inclusion in Maine Medical Center by an authorized administrator of MaineHealth Knowledge Connection. For more information, please contact [mckeld1@mmc.org](mailto:mckeld1@mmc.org).

---

**Authors**

A Bilkanovic, Z Haxhija, L Lucas, J Dziodzio, R R. Riker, T May, H Friberg, and D B. Seder

# Neurocardiac risk stratification 6 hours after resuscitation from cardiac arrest

A Bilkanovic<sup>1</sup>; Z Haxhija<sup>1</sup>; L Lucas<sup>2</sup>; J Dziodzio<sup>2</sup>; RR Riker<sup>2</sup>; T May<sup>2</sup>; H Friberg<sup>1</sup>; DB Seder<sup>2</sup>



## Introduction

- An increasing number of patients are resuscitated from out-of-hospital cardiac arrest. Triage to optimal treatment pathways could improve and increase the efficacy of post-resuscitation care.
- Despite great variability in etiology, duration, and patterns of injury from cardiac arrest, post-resuscitation treatment guidelines emphasize standard treatments. We hypothesize that by categorizing competing risks very early after resuscitation, it may be possible to improve the efficacy and efficiency of care.
- When measured very early after resuscitation, suppression ratio (SR, the percentage of suppressed EEG), correlates with severity of brain injury and the likelihood of poor neurological outcome<sup>1</sup>.
- The CREST score<sup>2</sup> is a validated model to predict circulatory-etiologic death (CED) based on: Coronary artery disease, initial non-shockable Rhythm, Eejection fraction <30%, circulatory Shock at admission and Time to ROSC >25 minutes.

## Aim

To develop an early neurocardiac risk stratification model based on the competing risks of death due to neurological injury or circulatory failure, using SR and the CREST score measured within 6 hours of resuscitation.

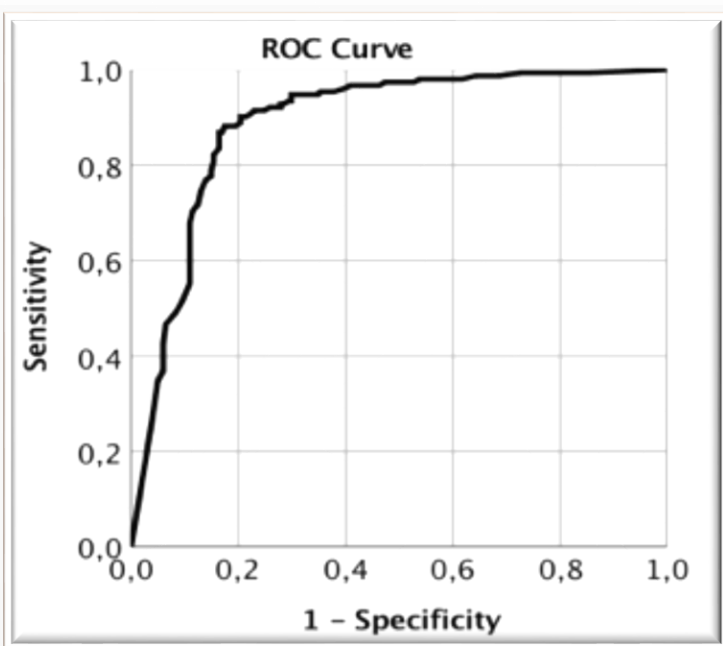
## Methods

- Serially admitted patients with out-of-hospital adult cardiac arrest to Maine Medical Center and registered in the INTeRnational Cardiac Arrest Registry were included. This research was approved by the MMC Institutional Review Board (ethics committee).
- SR at 6 hours after ROSC (SR<sub>6</sub>) was obtained from recorded bispectral index monitor data in patients that received neuromuscular blockade, and used to predict neurological-etiologic death (NED). A ROC curve was used to assess diagnostic accuracy. (Fig 1)
- Patients were divided into approximate deciles to help select clinically appropriate cutoffs for the risk of NED. (Fig 2)
- Similarly, the CREST score was dichotomized into low (10-20%; a score of 0-2) and high (30-56%; a score of 3-5) risk of circulatory-etiologic death (CED)<sup>2</sup>.
- The circulatory and neurological risk categories were combined with to create risk groups with very different profiles. (Fig 3)

## Results

- Of 543 patients, 353 had adequate data for the SR<sub>6</sub> analysis (Fig. 1), and 201 full data for risk category determination (Fig. 3)

**Figure 1. SR<sub>6</sub> predicted NED with an area under the ROC curve of 0.89 (CI 0.85-0.92), n=353.**



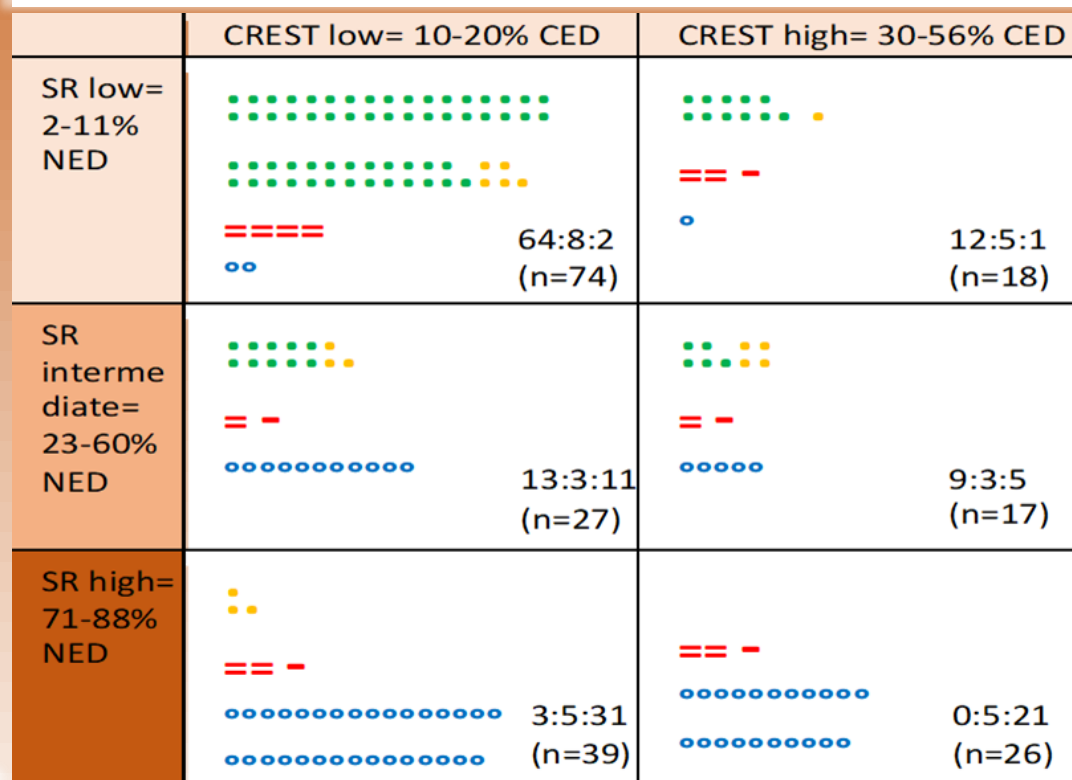
**Figure 2. Patients divided into risk deciles and risk categories for Neurological-etiologic death based on SR<sub>6</sub> and clinical utility**

| DECILE | PATIENTS (N=353) | SR <sub>6</sub> (%) | RISK OF NED | Thresholds for NED |
|--------|------------------|---------------------|-------------|--------------------|
| 1      | 31 (9%)          | 0                   | 3%          | Low risk           |
| 2      | 43 (12%)         | 1-3                 | 2%          |                    |
| 3      | 32 (9%)          | 4-13                | 6%          |                    |
| 4      | 35 (10%)         | 14-36               | 11%         |                    |
| 5      | 35 (10%)         | 37-63               | 23%         | Intermediate risk  |
| 6      | 38 (11%)         | 64-82               | 60%         |                    |
| 7      | 33 (9%)          | 83-90               | 88%         | High risk          |
| 8      | 35 (10%)         | 91-96               | 71%         |                    |
| 9      | 22 (6%)          | 97-99               | 82%         |                    |
| 10     | 49 (14%)         | 100                 | 84%         |                    |

## Results

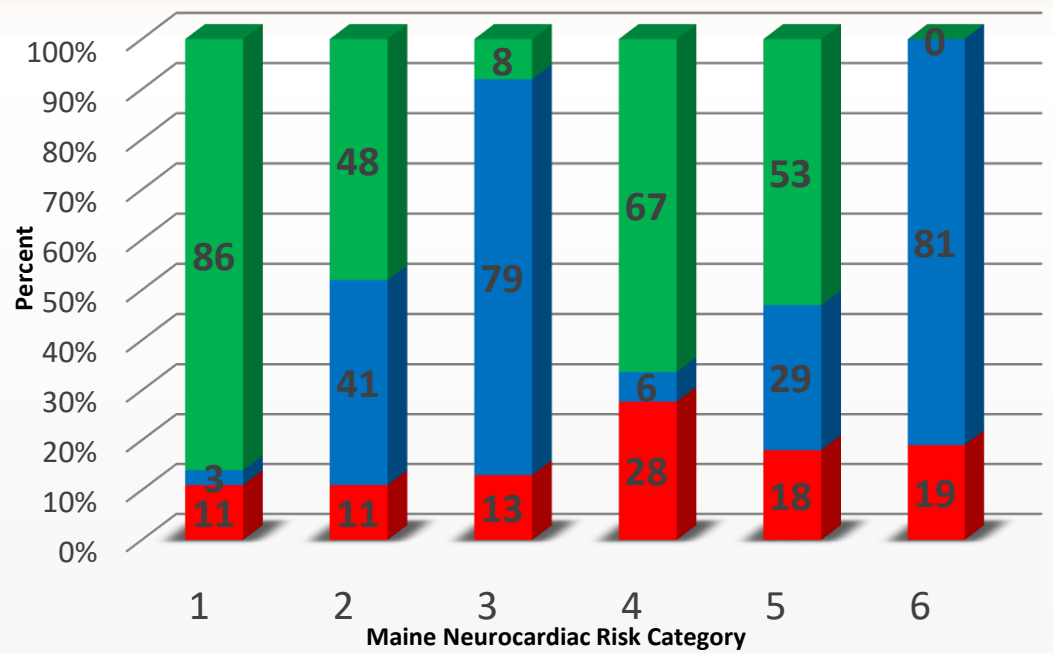
**Figure 3. The Maine Neurocardiac Risk Categories:**

Alive: CED: NED; green dot=Alive with good outcome; yellow dot=Alive with poor outcome; red bar = circulatory death (CED); blue circle = neurological death (NED). n=201



**Figure 4. Visual display of relative risk by category**

Outcomes in the risk groups. ■ = Alive; ■ = CED; ■ = NED.



## Discussion

- Using easily obtained data available early after resuscitation from out-of-hospital cardiac arrest, we demonstrated wide variation in risk profiles for neurological- and circulatory-etiologic death.
- When the risk of CED is high compared to NED, patients may benefit from early coronary interventions or other resource-intensive therapies to support the failing circulation.
- When the relative risk of NED is high, mechanical circulatory support and early revascularization may not significantly influence outcomes, but the population is ideal to test experimental neuroprotective therapies.
- The Maine Neurocardiac Triage Categories could be used to triage patients to different therapies or treatment locations, to select patients for clinical trials, and to improve cost-effectiveness of care. Prospective validation in other cohorts is needed.

## Conclusions

- Neurocardiac risk stratification can be performed at 6 hours after resuscitation using suppression ratio and the CREST score.
- The Maine Neurocardiac Triage Categories might be used to tailor (individualize) treatments for a specific patient based on their physiology, optimizing outcomes, reducing cost and resource utilization by eliminating futile or unnecessary care, and selecting similar phenotypes of patients for clinical trials, especially in the beleaguered group at high risk of NED.

## References

- Seder DB. The Bispectral Index and Suppression Ratio Are Very Early Predictors of Neurological Outcome During Therapeutic Hypothermia After Cardiac Arrest. *Intensive Care Med.* 2010;36(2):281-8.
- Bascom KE. Derivation and Validation of the CREST Model for Very Early Prediction of Circulatory Etiology Death in Patients without STEMI after Cardiac Arrest. *Circulation.* 2018;137(3):273-82.