Air Medical Journal 000 (2023) 1–3

Contents lists available at ScienceDirect

Air Medical Journal

journal homepage: http://www.airmedicaljournal.com/

Case Report

Pushing Yourself to the Maximum: What Do Prehospital Interventions Do to the Heart Rates of the Prehospital Team Involved? A Case Report

Sarah Morton, MBBS, FRCA, FFICM, DipIMC [1,2,*], Zoey Spurgeon, BSc Hons [1], Pete Sherren, MBBS, FRCA, FFICM, EDIC, DRTM [1], Neal Durge, MBBS, FRCEM [1]

[1] *Essex and Herts Air Ambulance, Earls Colne, Colchester, United Kingdom*
[2] *Imperial College London, South Kensington, London, United Kingdom*

A B S T R A C T

Little is known about the heart rate changes of prehospital clinicians when performing potentially "stressful" interventions. This case report demonstrates the heart rate changes of two prehospital clinicians when performing a resuscitative thoracotomy. It demonstrates the peak heart rates correlating to the main intervention performed. This highlights areas for future research including the effect heart rate has on optimal performance.

Within the prehospital world, it is recognized that practitioners are regularly exposed to a wide variety of stresses that can have a lasting effect on practitioners' mental health.[1] However, relatively little is known about how this stress can impact physical health or performance under stress. One study of prehospital physicians showed that missions resulted in potentially significant electrocardiographic (ECG) changes.[2] Some clinical simulation studies have shown that heart rates can peak around 140 beats/min.[3] An increased heart rate may be a normal sympathetic response to a challenge or the threat that the body is perceiving, but there is concern that stress can impede performance.[4,5] However, with limited data, it is hard to draw conclusions. This case report demonstrates the changes that can occur in prehospital clinicians' heart rates during a "stressful" mission (a resuscitative thoracotomy) and allows us to consider the wider implications of this.

Case Report

Two female prehospital clinicians working as a level 3 prehospital clinical team (physician and critical care paramedic, both age 32 years) performed their first resuscitative thoracotomy following the Essex and Herts Air Ambulance standard operating procedure on a traumatic cardiac arrest patient.[6] The patient had achieved return of spontaneous circulation (ROSC) before their arrival. After prehospital anesthesia, blood resuscitation, thoracostomies, and packaging, on hospital departure, the patient rearrested, and a resuscitative thoracotomy was performed. ROSC was achieved after aortic compression and internal cardiac massage, with the patient transported to the hospital in sustained ROSC.

Both clinicians maintain a level of baseline fitness, with an average resting heart rate of 52 beats/min for the physician and 56 beats/min for the paramedic. Both wore lifestyle devices that recorded their heart rates throughout (Apple Watch [Apple, Cupertino, CA] and Venu [Garmin, Olathe, KS]) that doubled as cleanable watches to facilitate timing (as per the Essex and Herts Air Ambulance infection prevention and control standard operating procedure).

Figure 1 details the heart rate changes, and Table 1 provides the timeline. Neither experienced any symptoms during the mission (eg, palpitations or chest pain). The weighted NASA Task Load Index score (estimate of stress levels) for the paramedic was 76.00, and for the physician, it was 65.67.[2] The heart rate peaked at 159 beats/min for the prehospital paramedic and 155 beats/min for the prehospital physician. Consent was gained from the clinicians involved to publish these data.

Discussion

This data set offers a unique insight into the physiological changes and stresses that can occur in a prehospital environment. The timing of the peak heart rates aligns with the most invasive procedure (and

*Address for correspondence: Sarah Morton, Essex and Herts Air Ambulance, Flight House, The Business Centre, Earls Colne Business Park, Earls Colne, Colchester CO6 2NS, UK.
E-mail address: sarah.morton@doctors.org.uk (S. Morton).

1067-991X/$36.00

https://doi.org/10.1016/j.amj.2023.01.008

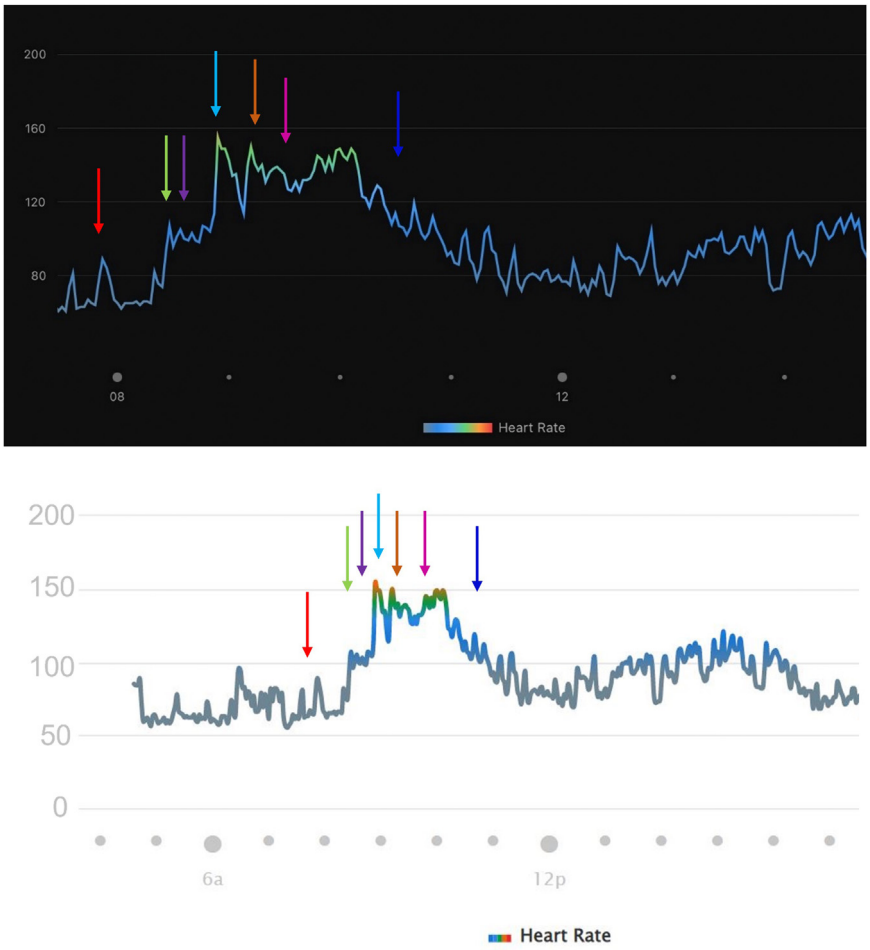

Figure 1. The heart rate changes observed during the mission for the critical care paramedic (bottom) and the prehospital physician (top) with the arrows indicating events (Table 1).

therefore the most stressful). This differs from the study in prehospital physicians that showed the most ECG changes during the activation phase of a mission.[2] The weighted NASA Task Load Index scores for that study match the "stressful mission" scores where ST changes were previously noted, suggesting there may well have been associated ECG changes for the clinicians involved.[2]

Controversy exists about the optimal heart rate at which we perform best. Many are aware of the inverted U theory and the optimal zone in which to perform.[7] At a heart rate above 145 beats/min, complex motor skills may be lost with an impact on auditory and visual bandwidths before this.[8] It remains unclear what a brief peak is likely to mean for these skills and performance. More research is required among prehospital clinicians to establish the long-term effect of stress on the cardiac system and performance. A deteriorating patient or a sudden change in patient condition, both stressful events, are linked to incidents in which mistakes were made.[9] Both of these may be hypothesized to provide a "challenge" for a prehospital clinician and evoke a sympathetic response.[5] "Panic" was also identified as a significant contributor to mistakes; future research that establishes a threshold for heart rates that differentiates panic from a challenge would be useful.[5,9] Additionally, alerting practitioners at heart rate peaks may allow them to re-evaluate their performance.

These data suggest that the physical fitness of our prehospital clinicians must remain an important consideration. Fitness testing is part of the recruitment for UK prehospital emergency medicine training, but staff can be recruited without this. Although the baseline heart rate is unlikely to be significant, the heart response to exercise or a "challenge" may be important because this could be the time in which symptoms, including ECG changes, might occur. Therefore, we would suggest that fitness testing and maintenance of physical fitness require consideration.

Although this is only a case report from one team's experience, we believe it highlights areas for future research to ensure the safety, longevity, and optimal performance of our prehospital workforce. We would encourage others to consider heart rate and other physiological surrogates on perceived performance along with more objective and subjective data.

Table 1
A Timeline of the Job Attended

Time	Event	Arrow on Figure
07:50	Dispatch	Red
08:28	Patient side	Green
08:42	Prehospital anaesthetic	Purple
09:00	Resuscitative thoracotomy	Light blue
09:12	Left scene	Orange
09:29	Handover of patient with ongoing medical assistance offered	Pink
10:40	Left hospital for debrief	Dark blue

References

1. The Royal College of Surgeons of Edinburgh: The Faculty of Pre Hospital Care. *Valuing staff, valuing patients: the report on the psychosocial care and mental health*

programme. Available at: https://fphc.rcsed.ac.uk/media/3140/valuing-staff-valuing-patients.pdf Accessed December 1, 2022.
2. Maleczek M, Schebesta K, Hamp T, et al. ST-T segment changes in prehospital emergency physicians in the field: a prospective observational trial. *Scand J Trauma Resusc Emerg Med*. 2022;30:47.
3. Clarke S, Horeczko T, Cotton D, Bair A. Heart rate, anxiety and performance of residents during a simulated critical clinical encounter: a pilot study. *BMC Med Educ*. 2014;14:153.
4. Kemeny ME. The psychobiology of stress. *Curr Dir Psychol Sci*. 2003;12:124–129.
5. LeBlanc VR. The effects of acute stress on performance: implications for health professions education. *Acad Med*. 2009;84:S25–S33.
6. Almond P, Morton S, OM M, Durge N. A 6-year case series of resuscitative thoracotomies performed by a helicopter emergency medical service in a mixed urban and rural area with a comparison of blunt versus penetrating trauma. *Scand J Trauma Resusc Emerg Med*. 2022;30:8.
7. BBC. Mental preparation. 2022. Available at: https://www.bbc.co.uk/bitesize/guides/zyx7tyc/revision/2#:~:text=The%20′inverted%20U'%20theory%20proposes,levels%2C%20performance%20quality%20is%20low. Accessed December 2, 2022.
8. Grossman D. *OnCombat, The Psychology and Physiology of Deadly Conflict in War and in Peace*. 3rd ed. Millstadt, IL: Warrior Science Publications; 2008.
9. Price R, Bendall JC, Patterson JA, Middleton PM. What causes adverse events in prehospital care? A human-factors approach. *Emerg Med J*. 2013;30:583–588.