Gestalt for Shock and Mortality in the Emergency Department: A prospective study

Abstract

Objective

The diagnosis of shock in patients presenting to the emergency department (ED) is often challenging. We aimed to compare the accuracy of experienced emergency physician gestalt against Li's pragmatic shock (LiPS) tool for predicting the likelihood of shock in the emergency department, using 30-day mortality as an objective standard.

Method

In a prospective observational study conducted in an urban, academic ED in Hong Kong, adult patients aged 18 years or older admitted to the resuscitation room or high dependency unit were recruited. Eligible patients had a standard ED workup for shock. The emergency physician treating the patient was asked whether he or she considered shock to be probable, and this was compared with LiPS. The proxy 'gold' or reference standard was 30-day mortality. The area under the receiver operating curve (AUROC) was used to predict prognosis. The primary outcome measure was 30-day mortality.

Results

A total of 220 patients fulfilled the inclusion criteria and were included in the analysis. The AUROC for LiPS (0.722; sensitivity=0.733, specificity=0.711, $P<0.0001$) was greater than emergency physician gestalt (0.620; sensitivity=0.467, specificity=0.774, $P=0.0137$) for diagnosing shock using 30-day mortality as a proxy (difference $P=0.0229$). LiPS shock patients

were 6.750 times (95%*CI*=2.834-16.076, *P*<0.0001) more likely to die within 30-days compared with non- shock patients. Patients diagnosed by emergency physicians were 2.991 times (95%*CI*=1.353-6.615, *P*=0.007) more likely to die compared with the same reference.

Conclusions

LiPS has a higher diagnostic accuracy than emergency physician gestalt for shock when compared against an outcome of 30-day mortality.

Introduction

Shock is often difficult to diagnose in the emergency department (ED) and delays in recognition and treatment adversely affect patient survival [1, 2]. At the bedside, doctors identify shock using clinical history, health status, vital signs, examination, and easily available investigations such as urine output and blood lactate [3, 4]. Appling a clinical diagnostic algorithm using these components which are generated based on the physician expertise is a way to improve diagnostic accuracy [5, 6]. Recently there has been increased interest in evaluating the role of clinician experience, otherwise known as gestalt, in the assessment of disease [7] or prediction of the treatment failure [8], and some studies have concluded that emergency physician gestalt is not sufficiently accurate [9, 10]. Thus, there is a need to investigate emergency physician gestalt for diagnosing shock in the ED phase of care [11].

Accepting that patients present along a spectrum of clinical severity and that shock lies on this spectrum, we have recently validated a pragmatic tool – Li's *a priori* Pragmatic Shock (LiPS) strategy – for identifying possible and probable shock in the emergency setting. This strategy consists of the following components, systolic blood pressure (SBP), mean arterial pressure (MAP), clinical impression of tissue perfusion, blood lactate, pH and base deficit. Furthermore, when shock presents, the patient is classified according to peripheral skin temperature (see Table 1) [3]. When applying this novel protocol in the clinical setting, we need to demonstrate that it is at least as good as clinical gestalt, if not better. A proxy for the difference between clinical gestalt and LiPS for determining shock in the ED are differences in 30-day mortality. We considered that the difference between clinical gestalt and LiPS was significant if the area under the receiver operator curve or the odds ratio for predicting 30-day mortality was statistically siignificanty different.

Thus, we aimed to determine the accuracy of experienced emergency physician gestalt for detecting and predicting likelihood of shock in the ED compared with LiPS using 30-day mortality as the gold or reference standard.

Materials and Methods

Study Design and Eligibility

The Clinical Research Ethics commission of The Chinese University of Hong Kong approved a prospective, single-centre study in the ED of the Prince of Wales Hospital, Hong Kong, SAR, China. Written consent was obtained from each patient or their relatives. Patient enrolment occurred between July 2012 and August 2014, 9 am to 4 pm on each weekday. Adult patients who were at least 18 years old and presented to two resuscitation rooms or three high dependency units (HDUs) were recruited. The HDU is a unit of three separate cubicles with continuous cardiac monitoring located in ED. It can provide intensive and emergency medical care for patients. In a five-point triage scale where category 1 is critical (immediate assessment), category 2 is emergency (medical assessment within 15 minutes), category 3 is urgent (medical assessment within 30 minutes), category 4 is semi-urgent, and category 5 is non-urgent, the HDU will accept category 2 or 3 depending on available beds and staff. The exclusion criteria were: less than 18 years old, pregnant, and breastfeeding.

Data Collection and Definitions

Two cohorts of data were collected for the present study, 111 patients from the original publication [3] and a further 109 patients from a subsequent unpublished dataset.

When assessing patients, emergency physicians gave their opinion, based on all available data in the emergency department, whether they thought the patient had shock, and if so, the type of shock. According to LiPS, patients were first classified into one of three groups: no, possible or probable shock. In the probable shock group, patients were further divided according to peripheral (hand) temperature – cold, warm or hot peripheries [3, 12].

Questions

In the emergency department, physician doctors were asked: Did you think that this patient is in shock? If yes, what kind of shock do you think that the patient has?

Outcome measures

The primary outcome was 30-day all-cause mortality.

Statistical analysis

All analyses were conducted using Medcalc version 15.8. Quantitative parameters are presented as mean ± standard deviation (SD). Comparisons of quantitative parameters were analyzed by one-way analysis of variance (ANOVA) or Kruskal-Wallis tests. Bonferroni tests between groups were conducted if the *P* value of the ANOVA tests were less than 0.05. Qualitative parameters were analyzed by Chi-squared test as appropriate. Area under the receiver operating characteristic (AUROC) curve analyses were performed to predict prognosis. Odds ratios (ORs) with 95% *CI*s were calculated. A *p*-value of less than 0.05 was considered to be statistical significant.

Results

Study participants

During two data collection periods – July 2012 to January 2013 and December 2013 to August 2014 – a total of 220 patients (mean age 69.36 ± 15.88years; male 62.73%) fulfilled the inclusion criteria and were evaluated. Of these 220 patients, 37 (16.82%) patients were classified as 'No Shock',106 (48.18%) patients as 'Possible Shock',32 (14.55%) patients as 'Cold Peripheries Shock', 40 (18.18%) patients as 'Warm Peripheries Shock' and five (2.27%) patients as 'Hot Peripheries Shock'.

Comparison of clinical symptoms, laboratory results and outcome.

Table 1 shows the comparison of clinical variables consisted in the LiPS definition among the five groups. There were significant differences between groups. Cold peripheries shock and hot peripheries shock group had lower SBP and MAP, whilst cold peripheries shock and warm peripheries shock patients had lower pH and BE. The probable shock group patients had higher lactate. Among the five groups, the cold peripheries shock patients had the highest 30-day mortality (46.88%, $P<0.01$), whilst the hot peripheries shock cases were more likely to be sent to ICCU (80%, $P=0.0012$).

Accuracy Analysis

Table 2 and Figure 1 shows the accuracy of emergency physicians' gestalt for shock compared with LiPS. The AUROCs of emergency physicians and LiPS were 0.620 (95%*CI*=0.552-0.685, $P=0.0137$) and 0.722 (95%*CI*=0.658-0.780, $P\leq0.0001$) respectively (difference 0.102 ($P=0.0229$)).

When the LiPS 'possible shock group' is excluded (N=106), Table 3 shows the agreement in shock assessment between emergency physicians gestalt and LiPS (N=114). In 74/114 cases, there was agreement between doctors' gestalt and LiPS. Of 37 patients who were classified as 'probable shock' by LiPS but 'no shock' by emergency physicians, 32 cases had either a metabolic acidosis (N = 22) or a high lactate level (N =17) or both metabolic acidosis and a high lactate level (N = 5). 32 patients had a systolic pressure >90 mmHg and 34 patients had a mean arterial blood pressure >65 mmHg. Eight of 37 (21.6%) patients in this subgroup died within 30 days.

Table 4 presents the odds ratios for 30-day mortality. Emergency physicians (OR=2.991, 95%*CI*=1.353-6.615, *P*=0.007) were less likely to identify probable shock than LiPS (30-day mortality OR=6.750, 95%*CI*=2.834-16.076, *P*<0.0001). Especially in cold peripheries shock patients diagnosed by LiPS, 30-day mortality was 10 times higher than the non-cold shock patients (95%*CI*=4.255-24.339, *P*<0.0001).

Discussion

This study has extended research from our previous study. To our knowledge, we were the first team to use objective ED-based clinical variables to develop an *a priori* definition of shock i.e. LiPS. LiPS not only included a classification of shock, but also the severity of shock. The clinical gestalt for shock in the ED was a holistic clinical impression of patients made by emergency physician, which was partly subjective and susceptible to interference [13]. The accuracy and variability of a doctors' judgment which comprises a complex and immeasurable number of variables is difficult to determine [14]. This study aimed to compare the accuracy of

emergency physicians' gestalt with LiPS for diagnosing probably shock, whilst using 30-day mortality as an objective proxy reference.

We first compared the prediction accuracy difference by AUROC tests of 220 patients. Emergency physicians could make their judgments based on available information in the emergency department. Applying 30-day mortality as a reference standard, emergency physicians identified less than 50% patients (14/30) with probable shock. On the other hand, emergency physicians were more accurate at identifying patients without shock (147/190), with a specificity which was slightly higher than LiPS'. However, overall, LiPS had a higher sensitivity than clinical gestalt.

Emergency physicians are under work and time pressure to make a diagnostic decision and to correctly manage critically ill patients, and this is often based on a limited amount of material and on clinical experience [15]. Doctor may misunderstand the severity of disease [16], and may take no account of laboratory results[17], which have been proven to predict adverse outcome [18-20]. Further evidence to support this may be found in the 37 patients classed as probable shock by LiPS but who were classified as 'no shock' by emergency physicians, and most of whom had a systolic pressure >90 mmHg or mean artery blood pressure >65 mmHg. The relatively normal blood pressure may be interpreted as a stable and relatively low risk patient. An increased probability of shock could have been noted not only by a high lactate level but alternatively by the degree of metabolic acidosis. Presently there is a high focus on lactate levels in critically ill ED patients but less focus on metabolic acidosis, despite the fact that acidosis probably reflects shock and tissue hypoxia more accurately than lactate, since elevated lactate may be related to drugs or toxins which is independent to shock or hypoxia [21, 22]. The majority of these patients were in metabolic acidosis not hyperlactacidemia. The mortality in

this group is significant as eight (21.6%) patients died within 30 days, and were not admitted to ICCU. These patients may have been overlooked because laboratory results were either not available at an early stage, or because their significance was not appreciated. Our data suggests that metabolic acidosis and decreased bicarbonate levels may alert clinicians to the possibility of shock in the presence of normal or only moderately elevated lactate, and should be incorporated in future guidelines and assessments.

We have developed a pragmatic tool for shock assessment whereby cold peripheries usually suggest vasoconstrictive shock and warm peripheries suggest vasodilatory shock. Although this association is not absolute, in our previous study [3] we found that this categorization did equate to very different mortality outcomes. There are undoubtedly exceptions to this rule whereby cold hands equate to vasoconstriction and warm hands equate to vasodilatation. However, until a reliable technique for assessing systemic vascular resistance such as USCOM is easily and readily available in ED, and incorporated into shock assessment, the rule applies in the majority of cases. In fact, we have confirmed this in another unpublished study (TR, personal communication).

The subgroup of cold peripheries shock patients classified using LiPS, most of whom were considered to be in late stages of shock, had an odds ratio of 10 for 30-day mortality. Thus, LiPS has the potential to identify both the presence and severity of shock.

Following the diagnostic protocol, and using point of care tests, it should not take more than 10 minutes to determine the probability of shock in the ED in a given patient. However, our study identified parameters, which may further improve the accuracy of shock and could be evaluated in further refinements of LiPS. These include temperature, shock index, SBP-DBP difference, hemoglobin, white cell count and renal function. In addition, non-invasive hemodynamic devices

have the ability to measure systemic vascular resistance, cardiac output, preload, cardiac power and oxygen delivery, all of which may further improve shock diagnosis [23, 24].

A number of limitations in our study should be acknowledged. Though we extended our previous preliminary study with 220 patients, the current research was a single-centre study. The result of this study might be influenced by the working system of the emergency department, and the patient source composition. In our opinion, though the trend of advantage of applying the LiPS in emergency department was clear, it is still necessary to conduct a multi-centre study. Further, we have not compared LiPS against other potential early risk tools such as NEWS or qSOFA.

Despite these limitations, our study shows some interesting findings. The LiPS was more accurate in diagnosing shock than experienced ED medical gestalt when compared against an outcome of 30-day mortality. Further, patients fulfilling the LiPS definition to be diagnosed with shock were 6 times more likely to die in 30 days, especially in those patients who were diagnosed with cold peripheries shock.

Conclusion

In our ED-based pragmatic study, LiPS was more accurate overall than clinical gestalt for determining shock using 30-day mortality as an objective proxy reference. The LiPS tool may be used in the ED for improving the diagnosis of shock and for research.

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