CORRESPONDENCE

B-type natriuretic peptide and echocardiographic indices of left ventricular filling in critically ill patients with severe sepsis: a cohort study

Editor—Sepsis has multiple and complex effects on the heart that are often difficult to identify clinically. Invasive haemodynamic measures have been used to tailor appropriate therapies, but their benefits have been questioned and there is increasing interest in non-invasive methods to identify and treat cardiac dysfunction in the intensive care unit (ICU). These include biomarkers such as B-type natriuretic peptide (BNP), which is released in response to volume expansion and pressure overload.[1] In addition, the echocardiographic ratio of peak early transmitral flow velocity to peak early diastolic mitral annulus velocity (*E*/*e*′ ratio) has been extensively validated as a correlate of left ventricular (LV) filling pressure and cardiovascular prognosis.[2 3]

Both BNP and the *E*/*e*′ ratio have been studied as markers of prognosis in critically ill patients with severe sepsis, but the data are limited and conflicting.[4–7] Likewise, few studies have assessed the relationship between BNP levels and the *E*/*e*′ ratio in patients with sepsis. After obtaining local Ethics Committee approval, we studied this relationship in 22 consecutive patients admitted to ICU with severe sepsis or septic shock.[8 9] Echocardiography was performed within 24 h of admission to ICU, and blood samples for BNP obtained concurrently. Results were analysed using the Mann–Whitney *U*-test, the Wilcoxon matched-pair signed-rank test, and the log-rank test.

Patient details are shown in Table 1. The median baseline BNP levels were non-significantly lower ($P=0.27$) in patients with severe sepsis ($n=7$; 131 pg ml^{-1}, IQR 68–533 pg ml^{-1}) compared with septic shock ($n=15$; 535 pg ml^{-1}, IQR 105–830 pg ml^{-1}). There was no significant difference in the *E*/*e*′ ratio between patients with severe sepsis and septic shock [11.4 (8.7–16.3) *vs* 15.6 (11.0–21.4); $P=0.26$]. Nine patients had evidence of elevated LV filling pressures (*E*/*e*′ >15). There was no significant difference in the ejection fraction of patients with severe sepsis and septic shock [60 (55–70)% *vs* 55 (35–65)%; $P=0.68$].

BNP and *E*/*e*′ were highly correlated ($r=0.87$, $P<0.001$), with an inverse correlation between BNP and the septal *e*′ velocity ($r=-0.81$, $P<0.001$). A weaker correlation ($r=0.53$, $P=0.02$) was also observed between BNP levels and indexed left atrial volume, an indicator of medium to long-term LV filling pressure. The relationship between BNP levels and estimated LV ejection fraction was not significant ($r=-0.41$, $P=0.06$). Septic patients with *E*/*e*′ >15 had a higher median BNP [830 (IQR 666–1145) pg ml^{-1}] than patients with *E*/*e*′ ≤15 [96 (66–177) pg ml^{-1}; $P<0.001$]. All patients with an *E*/*e*′ ratio >15 had BNP levels above 333 pg ml^{-1}

Table 1 Characteristics of the study cohort. SD, standard deviation; IQR, inter-quartile range

Clinical characteristics	
Age [mean (range)]	63 (21–83) yr
Male [number (%)]	14 (64)
Hypertension [number (%)]	12 (55)
Diabetes mellitus [number (%)]	7 (32)
Prior myocardial infarction [number (%)]	6 (27)
History of heart failure [number (%)]	5 (23)
Current smoker [number (%)]	8 (36)
Statin [number (%)]	8 (36)
β-Blocker [number (%)]	11 (50)
ACE inhibitor [number (%)]	6 (27)
Body surface area [mean (SD)]	1.79 (0.28)
Baseline heart rate [mean (SD)]	99 (18) beats min^{-1}
Baseline mean arterial pressure [mean (SD)]	69 (9) mm Hg
Mechanical ventilation at time of study inclusion [number (%)]	18 (82)
Required inotropes [number (%)]	18 (82)
APACHE score at baseline [median (IQR)]	26 (19–33)
Echocardiographic characteristics	
Left ventricular ejection fraction [median (IQR)]	58% (46–66)
Left ventricular ejection fraction >50% [number (%)]	16 (73)
Mitral E-wave velocity [mean (SD)]	81 (65–100) cm s^{-1}
Mitral A-wave velocity [mean (SD)]	85 (65–94) cm s^{-1}
Mitral valve E-wave deceleration time [mean (SD)]	172 (145–195) ms
Mitral annulus septal systolic velocity (s'_{septal}) [mean (SD)]	7 (6–9) cm s^{-1}
Mitral annulus lateral systolic velocity ($s'_{lateral}$) [mean (SD)]	7 (6–9) cm s^{-1}
Mitral annulus septal early diastolic velocity (e'_{septal}) [mean (SD)]	6 (4–7) cm s^{-1}
Mitral annulus lateral early diastolic velocity ($e'_{lateral}$) [mean (SD)]	7 (6–9) cm s^{-1}
E/e'_{septal} ratio [median (IQR)]	13.8 (10.8–18.4)
E/e'_{septal} ratio >15 [number (%)]	9 (41)
Left atrial volume indexed to body surface area [median (IQR)]	22.5 (19.5–36.8) ml m^{-2}
Haematological characteristics	
White cell count [mean (SD)]	16.3×10^9 litre^{-1} (5.3)
Estimated glomerular filtration rate [mean (SD)]	50 ml min^{-1} 1.73 m^{-2} (34)
Estimated glomerular filtration rate <60 ml min^{-1} 1.73 m^{-2}	14 (64)
Cardiac troponin I [median (IQR)]	340 (0–428) ng litre^{-1}
B-type natriuretic peptide [median (IQR)]	333 (82–830) pg ml^{-1}

(the cohort median). One patient with $E/e' \leq 15$ had a BNP level above the median.

Seven patients (32%) died within 30 days. The median BNP level for these patients was 535 (457–1134) pg ml^{-1} compared with 134 (66–797) pg ml^{-1} in those who survived ($P=0.11$). Only one patient with a BNP level below the median of 333 pg ml^{-1} died within 30 days (9%) compared with six with BNP levels above the median (55%). The median E/e' level in patients who died was 16.3 (11.7–25.2) compared with 12.4 (9.0–17.6) in survivors ($P=0.13$). Five of the seven patients who died by 30 days had an E/e' ratio >15. When time to death was accounted for, both BNP levels above the median and an E/e' ratio >15 predicted 30 day mortality ($P=0.02$ and 0.03, respectively), whereas LV ejection fraction was not predictive.

This study demonstrates a close correlation between BNP levels and the E/e' ratio in patients admitted to ICU with severe sepsis and septic shock. The relationship between BNP levels and the LV ejection fraction was less strong. Both BNP levels and the E/e' ratio were higher in patients who died. These data suggest that measurement of BNP levels and/or the E/e' ratio (as part of a baseline echocardiographic examination) on admission to ICU could be used to screen septic patients for cardiac dysfunction and identify those at increased risk of early mortality.

Declaration of interest

None declared.

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Benefits and possible improvements of an anaesthesia information management system in a quality assurance programme

Editor—The efficiency of an anaesthesia quality assurance programme depends on many variables,[1] including individual and collective staff contribution, commitment of quality management director, but also the choice of indicators and their availability to monitor adequately the programme.[2] AIMS generates a huge amount of data which might be useful for this purpose;[3] here we report multiple contributions of our AIMS system (Datex Ohmeda® and Archive Browser®) in some parts of our quality assurance programme from 2002 to 2010. The system which is integrated in the AS5 Dragger anesthesia machine® automatically records vital signs and ventilator parameters, while anaesthesia providers manually index drug administration and medical intervention or administrative tasks in the operating theatre and the post-anaesthetic care unit (PACU). Our quality assurance programme targeted several areas of care and their related indicators including monitoring muscle relaxation, postoperative pain, and morphine consumption postoperative nausea and vomiting (PONV) and postoperative hypothermia. We used two methods to extract anaesthesia indicators: manual extraction of individual files in a PDF format for neuromuscular relaxation (sampling) and Structured Query Language (SQL) extraction for other indicators such as pain scores, opioid medications, and postoperative hypothermia (exhaustive approach). For each indicator, a programme of informations/meetings and correction/suggestions measures was initiated for operating theatre and PACU personnel. Data concerned 69 243 patients, the mean overall completeness of data was 95% for the last 5 yr, while for the initial years, it ranged from 55% to 85% and was indicator-dependent. The results of these queries revealed that the incidence of neuromuscular monitoring was initially 67%, it increased to 95%, $P<0.05$, and remained stable thereafter; the pharmacological reversal remained around 50% through the years. An improvement of severe postoperative pain scores and low PONV scores (1 and 2 in a five-grade scales) was observed through the years (Fig. 1), while mild postoperative hypothermia remained a challenge and stayed around 12%, despite multiple efforts through