Pelvic Ring Injury: Should We Notice Acid-Base Imbalance as Mortality Predictor?

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ABSTRACT

Introduction. *Young-Burgess classification system for pelvic ring fracture is popular because it is theoretically a mechanistic classification that is able to predict mortality. The inherent usefulness has led to its widespread use by both orthopaedic and general surgeon in guiding treatment. It can also predict associated injuries and the severity of hemorrhagic shock. Severe hemorrhagic shock will cause hypoperfusion of tissues which may lead to metabolic acidosis, one among the triad of death.*

Materials and methods. *Medical records of pelvic ring injury patients in Department of Orthopaedic and Traumatology Hasan Sadikin Hospital, Bandung during 2010 were retrospectively reviewed. Data about age, gender, mechanism of injury, Young-Burgess classification, base excess, lactate concentration, pH, and outcome in 24 hours were extracted. Non-parametric Kendall-Tau analysis was used to analyze the correlation among Young-Burgess classification and hemorrhagic shock class, base excess, lactate concentration, pH, and outcome in 24 hours. Kruskal-Walis test was used to determine the difference among Young-Burgess classification and hemorrhagic shock class, base excess, lactate concentration, pH, and outcome in 24 hours*

Results. *There were significant correlation between Young-Burgess classification and severity of hemorrhagic shock ($p<0.01$), haemoglobin ($p<0.01$), pH ($p<0.01$), and mortality ($p<0.01$). There were significant correlation between stability of fracture and hemorrhagic shock class ($p<0.05$), haemoglobin ($p<0.05$), pH ($p<0.05$), and mortality ($p<0.01$).*

Conclusions. *stability of fracture, severity of hemorrhagic shock, and acid-base imbalance will lead to higher mortality.*

Keywords*: acid-base imbalance, Young-Burgess classification, mortality, pelvic ring injury*

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Cedera Cincin Pelvis: Ketidakseimbangan Asam-Basa sebagai Prediktor Mortalitas?

ABSTRAK

Pendahuluan. Sistem klasifikasi Young-Burgess untuk fraktur cincin pelvis terkenal karena secara teoritis merupakan klasifikasi mekanis yang mampu memprediksi mortalitas. Keuntungan itu membuat sistem klasifikasi Young-Burgess digunakan secara luas oleh dokter bedah umum dan bedah orthopaedi untuk mengarahkan terapi. Sistem klasifikasi itu juga mampu memprediksi cedera penyerta dan keparahan syok hemoragik. Hipoperfusi pada syok akan mengakibatkan asidosis metabolik, yang merupakan salah satu dari trias kematian.

Bahan dan cara kerja. Rekam medis pasien cedera cincin pelvis di Departemen Orthopaedi dan Traumatologi Rumah Sakit Hasan Sadikin, Bandung sepanjang tahun 2010 dikaji secara retrospektif. Data mengenai usia, jenis kelamin, mekanisme cedera, klasifikasi Young-Burgess, base excess, kadar laktat, pH, dan keluaran dalam 24 jam diekstrak dari rekam medis tersebut. Uji Kendall-Tau digunakan untuk mencari korelasi klasifikasi Young-Burgess dengan kelas syok hemoragik, base excess, kadar laktat, pH, dan keluaran dalam 24 jam.

Hasil. Terdapat korelasi signifikan antara klasifikasi Young-Burgess dengan kelas syok hemoragik ($p<0,01$), hemoglobin ($p<0,01$), pH ($p<0,01$), dan mortalitas ($p<0,01$). Terdapat korelasi signifikan antara stabilitas fraktur dengan kelas syok hemoragik ($p<0,05$), hemoglobin ($p<0,05$), pH ($p<0,05$), dan mortalitas ($p<0,01$).

Simpulan. Stabilitas fraktur, keparahan syok hemoragik, dan ketidakseimbangan asam basa akan meningkatkan mortalitas.

Kata kunci: ketidakseimbangan asam-basa, klasifikasi Young-Burgess, mortalitas, cedera cincin pelvis

Introduction

Unstable pelvic fracture is a life threatening condition. Even in isolated injury, it may lead to serious problem. Initial management of that type of fracture, airway management, breathing and cervical spine control are the primary aims. Many of the victims has multiple injuries and requires definitive control of airway, mechanical ventilation and thoracic tube decompression.[1,2]

Attention must be paid to signs of hypovolemia shock. It is a silent killer, as 30% of blood volume has lost before hypotension is noted. When hypotension with systolic blood pressure of 90 mmHg or less already presents, at least 1 500 to 2 000 ml of blood loss has occured.[1,3]

The primary assesment must focus on possible sour ces of bleeding, such as external blood loss or internal bleeding in the thorax, abdomen, retroperitoneal cavity, pelvic, or long bone fractures, especially in the femoral shaft. The pelvic rock manouvere can demonstrate clinical instability of the pelvic ring, especially when the instability is gross. However, apparently normal examination could not exclude severe pelvic injury. Therefore, an anteroposterior x-ray of the pelvic should be included in the primary survey in all blunt trauma patients with signs of hypovolemic shock.[1,3,4]

The Young-Burgess classification system of pelvic ring fracture is popular because it is a mechanictic classification system that is theorized to predict mortality, tranfusion requirement, and non-orthopaedic associated injuries.

In anteroposterior compression injury with open book configuration, bleeding in enlarged volume of the pelvic cavity will almost certainly a venous origin, but arterial bleeding can not be excluded. With lateral impaction injury, there may be anterior venous bleeding from fracture site as well as arterial bleeding in complete disruption

of pelvic floor. Shearing forces that can result in bleeding from posterior as well as anterior part of pelvic ring. Type of fracture and magnitude of initial displacement is related to the severity of hypovolemic shock.[5,6]

Severity of hypovolaemic can illustrate hypoperfusion that occured. Hypoperfusion can cause mithochondria disruption so that its function to produce ATP is disrupted. The functions of ATP, such as in Na-K ATP dependent pump, glucose metabolism, protein synthesis, dampen free radical production, are further disrupted.[7] This condition can cause hyperlactacemia, irreversible cell death, and further organ dysfunction.

Several systemic adverse effect can occur because of organ dysfunction, such as metabolic acidosis, which are not uncommon in polytrauma patients, and must be considered as they may play major part in the therapeutic strategy.[8-10]

This study focused on trend of acid-base variable such as pH, pCO_2, standard base excess, and lactate concentration as predictors of outcome in correlation with hypovolaemic shock caused by some pattern of pelvic ring injury based on Young-Burgess classification.

Materials and Methods

We performed a retrospective review of medical records of 48 patients with pelvic ring fractures resulting from blunt trauma who were admitted to Hasan Sadikin General Hospital Trauma Bandung, from January to December 2010. All patients admitted during the period with radiographs showing pelvic ring fracture were included in the study. Patients with isolated fracture of iliac wing that did not affect the stability of the pelvic ring and those with gunshot wounds or concomitant acetabular fractures were excluded.

We assessed severity of hemorrhagic shock class, fracture classification based on Young-Burgess, pH, base excess, bicarbonate concentration, pCO_2, and lactat concentration. Outcome of the patient were also followed.

Kendall-Tau analysis was used to find correlation among Young-Burgess classification, hemorrhagic shock class, base excess, lactate concentration**,** pH, and outcome in 24 hours. Mann-Whitney analysis was used to calculate the differences among Young-Burgess classification, hemorrhagic shock class, base excess, lactate concentration**,** pH, and outcome in 24 hours.

Results

In our study, the average age of patients is 32.7 years (range 12–68 years), and 75% of them were men. Lateral compression type-1 was the most common injury observed. (Figure 1).

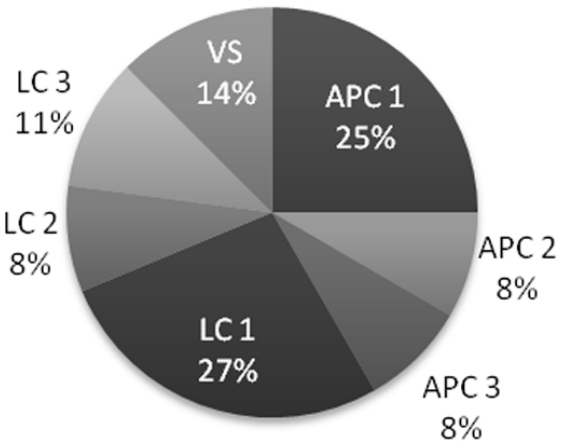

Figure 1. Distribution of fracture type. LC=lateral compression, APC=anterior posterior compression,

Based on Kendall-Tau analysis, Young-Burgess classification had positive correlation with hemorrhagic shock class and mortality and negative correlation with haemoglobin (Table 1).

Based on Mann-Whitney analysis, there were significant differences between stability of fracture pattern and hemorrhagic shock class, pH, and outcome after 24 hours. (Table 2)

Discussions

We found significant correlation between Young-Burgess classification and severity of shock, haemoglobin, pH, and mortality. There were significant differences between stability of the fracture and hemorrhagic shock, haemoglobin, pH, and mortality.

In unstable injury, more blood was lost. It will disrupt oxygen delivery needed for energy production leading to anaerob metabolism with lactate as end-product.

Table 1. Correlation among Young-Burgess classification and hemorrhagic shock class, base excess, lactate concentration, ph, outcome in 24 hours

	n	r	p
shock class	48	0.27	0.03
haemoglobin	48	-0.31	<0.01
lactate	45	0.11	0.31
base excess	47	-0.74	0.49
HCO_3	48	-0.85	0.43
pCO_2	48	-0.71	0.51
pH	48	-0.43	0.02
outcome in 24 hours	48	0.34	<0.01

Table 2. Difference among Young-Burgess classification and hemorrhagic shock class, base excess, lactate concentration, pH, and outcome in 24 hours

	difference	p
shock class	3.8 vs 1.8	0.04
haemoglobin	14.9 vs 9.2	0.20
lactate	3.5 vs 2.7	0.10
base excess		0.51
HCO_3	17.2 vs 18.4	0.43
pH	7.28 vs 7.4	0.03
Outcome in 24 hours	17 vs 4	<0.01

It causes metabolic acidosis in which mortality will increase.[8-10]

We found hyperlactacemia was not the only important element that cause metabolic acidosis. It is contrary to other study which found lactate as the only factor that correlated strongly with mortality in many types of shock. Lactate clearance through vigorous resuscitation strongly correlates with ultimate outcome, including mortality, organ failure, and infection.[8-11]

It is assumed that the other factors explained by Stewart must be taking part in metabolic acidosis that occur.[12,13]

When shock occurs, hepatic hypoperfusion will initiate cascade similar to endotoxin and the ions may be traceable to the liver. The unmeasured ionic species may represent release of previous intracellular species into circulation or a consequence of reprioritization of hepatic protein synthesis. Increased production of negatively charged acute phase proteins might help explain the increase in strong ion gap. Regardless genesis of these species, their utility in assessing mortality following vascular injury is readily apparent.[14]

Conclusions

Stability of fracture, severity of hemorrhagic shock, and acid-base imbalance will lead to higher mortality.

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