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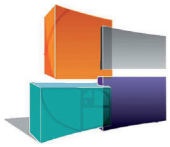

Monothematic meeting of Sfar

Operative care and surveillance in severe trauma patients. Interference between resuscitation treatments and anaesthesiology, and consequence on immunity☆,☆☆

Gestion des patients polytraumatisés au bloc opératoire, surveillance au bloc. Analyse des interférences entre traitements du choc et l'anesthésie, conséquences potentielles sur l'immunité

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ABSTRACT

Major trauma remains a worldwide cause of morbi-mortality. Early mortality is the consequence of hemorrhagic shock and traumatic brain injury. During early resuscitation, anaesthesia is often mandatory to perform surgery. It is mandatory to master the hemodynamic effects of hypnotic drugs in order to anticipate their potential deleterious effects in the setting of hemorrhagic shock. After early resuscitation, trauma patients present a high prevalence of nosocomial pneumonia, which sustains major morbidity. Nosocomial pneumonia are the consequence of an overwhelming systemic inflammatory response syndrome (SIRS) as well as a trauma-related immunosuppression. The administration of hemisuccinate of hydrocortisone modulates the SIRS and reduces the risk of nosocomial pneumonia as well as the length of mechanical ventilation. Finally in the operating theatre, fighting against hypothermia and un-anatomical positions, which can aggravate rhabdomyolysis, are both mandatory.

Mots clés:
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RÉSUMÉ

Les polytraumatismes restent une cause majeure de morbi-mortalité dans le monde. La mortalité initiale est essentiellement la conséquence du choc hémorragique et des traumatismes crâniens. Au cours du déchoquage, l'initiation de l'anesthésie est indispensable pour la prise en charge chirurgicale. Une bonne connaissance des effets hémodynamiques des hypnotiques au cours du choc hémorragique est indispensable afin d'anticiper leurs potentiels effets délétères. La morbidité au décours de la phase initiale est caractérisée par une forte prévalence de pneumopathie nosocomiale. Ces pneumonies sont la conséquence d'un syndrome inflammatoire d'origine systémique (SIRS) excessif et d'une immunosuppression post-traumatique. L'hémisuccinate d'hydrocortisone permet de limiter l'importance du SIRS et de diminuer le risque de pneumopathie nosocomiale ainsi que la durée de ventilation mécanique. Enfin au cours de la prise en charge au bloc opératoire, il est indispensable de lutter contre l'hypothermie mais

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également contre les installations non anatomiques sur la table chirurgicale pour ne pas majorer le risque de rhabdomyolyse.

1. Definitions

CO	Cardiac output
DNA	Deoxyribonucleic acid
MAP	Mean arterial pressure
MOF	Multiple organ failure
HPA	Hypothalamic-pituitary-adrenal
ICU	Intensive care unit
IL	Interleukin
NP	Nosocomial pneumonia
SIRS	Systemic inflammatory response syndrome
SOFA	Score of Organ Failure Assessment
TLR	Toll-like receptor

2. Introduction

Severe trauma remains a leading cause of death and morbidity worldwide and an actual global healthcare burden: approximately 6 million people die worldwide from injuries [1]. Early trauma-related mortality is secondary to brain injury or haemorrhagic shock and secondly to coagulopathy, which is induced by haemorrhagic shock but is also worsened by massive transfusion [2]. After resuscitation, trauma patients in the ICU may present NP and late multi-organ failure [2]. The aim of this review is to summarise the interaction between haemorrhagic shock and early anaesthesia, and its consequences on the endocrinian and the immune system.

3. Pathophysiology of haemorrhagic shock

Haemorrhagic shock is a main issue during the early management of severe trauma patients and bears significant mortality [2]. During the early phase of haemorrhagic shock, stimulation of the sympathetic nervous system preserves MAP via vasoconstriction of renal, splanchnic, muscular and cutaneous tissues [3]. This adaptation mechanism preserves coronary and cerebral blood flow. In the late phase, when the blood loss reaches up to 30–50% of the total blood volume, the sympathetic nervous system is overwhelmed. This leads to a delayed imbalance between the sympathetic and parasympathetic systems, and secondly to peripheral vasodilation with clinical hypotension and bradycardia [3].

During the early phase of severe trauma management, hypnotic drugs are widely used in order to start mechanical ventilation or perform surgical treatments. Haemodynamic effects of hypnotic drugs have been described in a dog model of haemorrhagic shock [4]. In this study, MAP decreases proportionally in anaesthetised dogs whereas a sympathetic autonomous system regulated plateau pressure is observed, before severe drop occurs in awake dogs. Although general anaesthesia is often mandatory in the setting of severe trauma, its haemodynamic consequences (decrease of MAP, CO), venous return, and alteration of the pressure sensitive response could be dreadful during the late phase of haemorrhagic shock. The choice of hypnotic drug is therefore of primary importance to avoid haemodynamic collapse.

4. Ketamine

Ketamine has been proposed during hypovolemia because of the marked haemodynamic effects such as hypertension and tachycardia in normovolemic animals [5] and humans [6]. However in a pig model of haemorrhagic shock, Weiskopf et al. [7], demonstrated that both ketamine and thiopental equally depressed systemic vascular resistance, MAP, heart rate and CO, after induction. In the late phase of resuscitation, epinephrine, norepinephrine and blood lactates were markedly higher in the ketamine group than in the thiopental group. The authors concluded that the sympathetic nervous system stimulation caused by ketamine is overwhelmed by its vasodilatory effects. Added to the potential elevation of intra-cerebral pressure [8], ketamine was left aside in the management of severe trauma. However, no recent data confirmed these quite old studies.

5. Propofol

Propofol is a worldwide used hypnotic drug. It has marked hemodynamic effects such as vasodilation and hypotension, decrease of venous return and CO and depresses the pressure-sensitive response [9,10]. In order to evaluate the exact effects of propofol during haemorrhagic shock, Johnson et al. [11] first demonstrated in a pig model, that propofol plasmatic concentrations were significantly higher in the shock group. This suggests that a dose reduction during hypovolemia could achieve the desired anaesthetic effect and limit its potential hemodynamic adverse effects. During resuscitation with crystalloids, potency of propofol is increased [12] suggesting that lower doses of propofol should be used. With cautious use, propofol could be an alternative for anaesthetic induction during haemorrhagic shock.

6. Etomidate

Etomidate is a hypnotic drug with very few hemodynamic side effects. Arterial pressure, venous return and CO are not modified after etomidate injection in healthy subjects [13] and in patients with cardiac failure [14]. However there is clinical evidence that single-shot injection of etomidate depresses the cortico-surrenal axis [15] and is involved in patients mortality when used as continuous sedation in the ICU [16]. Single-shot injection of etomidate for anaesthetic induction has also been incriminated to increase mortality in sepsis [17]. Those adverse effects were not pointed out in a large multicenter study [18]. Patients undergoing emergency general anaesthesia for various reasons such as trauma or severe sepsis were randomly assigned to receive either ketamine or etomidate for anaesthetic induction. There were no differences regarding the evolution of the SOFA score in the first three days in the ICU or the 28-day mortality [18]. There were also no differences between trauma or septic patients. Recently, a large north-American nationwide retrospective analysis showed no link between in-hospital mortality and etomidate administration in sepsis or septic shock [19]. Debate remains regarding the immediate beneficial haemodynamic effects of etomidate balanced by its potential adverse effects [20].

7. Morphinomimetics and curare agents

Considering morphinomimetics, haemorrhagic shock alters the pharmacokinetics of fentanyl. In a pig model of haemorrhagic shock, fentanyl plasma levels are two times higher than in controls [21] because of an alteration of the fentanyl distribution, as well as