

Burn injury during pregnancy

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ABSTRACT

Burn injuries represent an important health problem, resulting in severe comorbidity and even death. Described as one of the most uncommon conditions during pregnancy, burn injuries represent a challenge for obstetricians and health care providers among the world, primarily because of the need to find proper treatment options that could benefit both the future mother and the foetus. Diagnosis and treatment require the combined effort of a multidisciplinary team in order to find the best therapeutic options. Given the physiological changes that occur during pregnancy, the body's ability to respond as a result of the stress caused by a burn injury may be affected, while maintaining the viability of the fetus is also considered. Although there is a number of dressings which can be used in superficial burn injuries, in the case of a pregnant woman there are emerging concerns regarding absorption and toxicity. Nonetheless, treatment is individualized according to the degree of burn and gestational age.

Keywords: burn, injury, pregnancy, outcome

INTRODUCTION

Burn injuries represent an important health problem, resulting in severe comorbidity and even death. The treatment for burn injuries for individuals alone is difficult and requires many resources, but when it comes to burn injuries in pregnant women, there are several additional factors to be considered and more specialists are needed to be involved in the treatment of both mother and child. Among them, gynecologists, neonatologists and plastic surgeons need to work together to ensure the safety of both mother and child [1]. Described as one of the most uncommon conditions during pregnancy, burn injuries represent a challenge for obstetricians and health care providers among the world, primarily because of the need to find proper treatment options that could benefit both the future mother and the fetus. Besides the physical injuries

that involve a high rate of mortality and morbidity for both mother and fetus, burn injuries that affect pregnant women imply an important psychological feature. The resulting complications are related to the severity of the burn and treatment options are described according to gestational age. Nevertheless, diagnosis and treatment require the combined effort of a multidisciplinary team in order to find the best therapeutic options.

MATERIALS AND METHODS

The present paper aims to review data on pregnancy and burn injury as the incidence of burns during pregnancy remains low. Current literature was searched including online medical database such as PubMed and Google Scholar, 19 papers being included in the final review.

HEMODYNAMIC CHANGES DURING PREGNANCY

In order to adapt to the fetus, the pregnant body experiences anatomical and physiological changes that imply all organs and systems [2]. According to Lockitch et al., maternal biochemistry is strongly correlated to preconceptional hormonal changes, in order to obtain an adequate performance of the fetoplacental unit [2]. During pregnancy, plasma volume expands by 50%, while red blood cell mass undergoes a less accelerated growth leading to hemodilution and decreasing of hemoglobin and hematocrit levels and due to endothelium factors that lead to peripheral vasodilatation, cardiac output increases by 40%, while systemic vascular resistance decreases [3]. Osmoregulation during pregnancy includes the renin–angiotensin–aldosterone system and the sympathetic nervous system that are activated by the stimulation of arterial baroreceptors [4]. According to Davison et al. who studied osmoregulation in eight women during pregnancy and puerperium period, pregnant women plasma osmolality levels are lower, resulting into a hypervolemic, hypo-osmolar environment, having as the ultimate goal of maintaining the uteroplacental perfusion [4].

TYPES OF BURN LESIONS

Burn injuries constitute an ample pathology, which surpasses the local lesion. In pregnant women, burns with a total body surface area (TBSA) greater than 3% are recommended for admission for hospitalized monitoring and treatment [5]. The appropriate therapeutic approach depends on factors such as age, presence/absence of inhalation injuries, mechanism of injury (flame, contact, electrocution, explosion), TBSA, depth of the burned lesions, other comorbidities. Based on the depth of the burned area, the lesions can be divided into 3 categories: first degree (superficial burns), second degree (divided further into IIA - superficial and IIB - deep) and third-degree burns [6]. While first degree burns heal spontaneously without special treatment, for the superficial second-degree burns (IIA) blister removal followed by wound dressing is required. Both first degree and superficial second-degree injuries heal well in 14 days after the accident. For the deep second degree and third-degree burns, surgical treatment and special wound dressing are mandatory. For minor burns, the same therapeutic principles apply to pregnant and non-pregnant patients; hospitalization is rarely needed, and the burn injury requires wound dressings if there are blisters (otherwise the erythema subsides in the first 24 hours). Bacitracin can be used as a topical agent in case of superficial second degree while oral analgesic can be prescribed if the dressing change is painful [7].

BURN INJURIES AND PHYSIOLOGICAL CHANGES

After a major burn injury, a plethora of physiological changes occur, which may involve all organs of the human body. A correct assessment should be performed at the site, firstly the trauma assessment (including the airway, breathing and circulation), then the burn assessment in terms of local injuries (depth and surface, the latter estimated using the Wallace rule of 9). Once admitted to the emergency room, a central i.v. line and urinary catheter should be inserted. Laboratory tests should be performed in emergency and should include complete blood count, serum electrolytes and protein, arterial blood gases, blood, and wound cultures.

There are three stages in the evolution of the severely burnt pregnant patients: the critical/emergent period (48-72 hours), the acute stage (until all wounds are covered, usually up to 3 weeks) and the rehabilitative phase (in which the patients are socially reintegrated) [7]. In the emergent phase, a massive burn injury translates into increased membrane permeability and, consequently, in a loss of liquids and an electrolyte imbalance. The clinical result is the local edema. For injuries above 25% BSA, this edema extends to the non-injured areas. Escharotomies may be needed in case of circular constrictions which may cause arterial insufficiency or respiratory difficulties. Oral intubation should be performed when edema of the superior airways is suspected; otherwise in later evolution tracheostomy with intubation may become the only solution. Fluid therapy is essential for immediate resuscitation. Correct fluid therapy is vital not only for the maintaining the homeostasis, but it can also prevent the burned areas from increasing their depth. There are several formulas used for fluid resuscitation such as Parkland formula, Evans, formula, Brooke formula, Ruijin's formula [8].

The most frequently used is the Parkland formula, which determines the volume of liquids needed for 24 hours – $V \text{ (ml)} = 4 \times \text{body weight (kg)} \times \text{TBSA (\%)} \text{ x 24}$. The first half of the volume is to be delivered within 8 hours from the burn incident and the remaining half the next 16 hours. A recent study performed by Daniels et al. questioned whether the Parkland formula is the most adequate for determining the correct amount of liquids needed in the first 24 hours. The results of the retrospective study showed that a more restrictive fluid regimen had better results in terms of survival compared to the traditional Parkland formula [9]. Fluid resuscitation should be evaluated based on clinical assessment. Core temperature, pulse and adequate peripheral capillary refill are parameters to be monitored regularly in the first 72 hours, while hypotension, when present, should be considered as a late finding and an indicator of shock. The most re-

liable indicator for correct fluid resuscitation remains urine output. The aim is to achieve a urine output of 0.5 ml/kg/h [10].

For deep burns, silver sulfadiazine cream and early excision and grafting represent the standard of care in plastic surgery. Silver sulfadiazine is however of limited use in the case of pregnant women, as the Ag⁺ and sulfonamides can be absorbed through the skin; the silver ion is being investigated to have been later deposited in liver and kidneys, while the sulfonamides are a possible cause for kernicterus [11]. The main objective in large burns is to have all full thickness burn injuries closed with skin grafts (autografts), as the greater the burned surface, the bigger the risk of mortality, both for mother and infant. After this goal is accomplished, special care should be given to certain areas such as hands, face and perineum, which have both functional and aesthetic importance [7]. In the rehabilitative phase, the chest burn scars may constitute an impediment for breastfeeding [12].

PREGNANCY AND BURN INJURIES

Based on literature research, the incidence of burns during pregnancy remains low and proper guidelines are needed in order to find applicable treatment options that could benefit both the future mother and the fetus. Maternal-fetal outcome correlates with the total body surface area (TBSA) that is affected by burns and higher mortality rates are noted when more than 50% of the body surface is involved [13]. According to Mendez-Figueroa and al., overall burn injuries reported incidence is 2.6/100,000 person-years, while 0.17/100,000 person-years is reported in pregnant patients [14]. Given the physiological changes that occur during pregnancy, the body's ability to respond as a result of the stress caused by a burn injury may be affected and maintaining the viability of the fetus is also considered. Pregnancy is characterized by increased cardiac output and decreased peripheral resistance and when a burn injury takes place, capillary permeability and fluid loss are stimulated, resulting in hypovolemia, although hemodilution and hypervolemia play an initial protective role against hypovolemia [15]. If hypovolemia takes place, blood is redirected towards vital organs such as heart, brain, and kidneys, while uteroplacental perfusion is diminished, leading to complications such as placental insufficiency, fetal hypoxia and abortion, preterm birth, or stillbirth [16].

Treatment is individualized according to the degree of burn and gestational age. Regardless of gestational age, obstetric evaluation is needed. According to Chandra and al. who conducted a study on 19 cases of pregnant women, burn injuries that oc-

curred during first trimester involved a higher abortion rate, while maternal death was the least frequent during the first trimester [17]. During the first trimester, ex-utero survival is unattainable, and management includes eschar excision, thus decreasing prostaglandin and cytokine levels, fluid resuscitation, use of antimicrobial dressings and antibiotics [16,17]. Most burn injuries occur mainly during the second trimester, a critical period for fetus, when there is a reduced ex-utero survival and the condition of the fetus is strongly correlated to the mother's condition, while lung maturation is not properly attained [18]. Besides general measures that are also recommended during the first trimester, corticosteroids might be indicated for the acceleration of fetal lung maturation alongside electronic fetal monitoring and fetal ultrasound assessment [18]. Nonetheless, extensive burn injury that take place during the third trimester might imply delivery, tocolysis or emergency cesarean delivery [18].

Although there is a number of dressings which can be used in superficial burn injuries – silver dressings, silicon-coated nylon and biosynthetic dressings, which are considered to be more suitable than silver sulphadiazine cream, in the case of a pregnant woman there are emerging concerns regarding absorption and toxicity. However, systematic overviews of special dressings are scarce and therefore the efficacy of some dressings (chlorhexidine-impregnated paraffin gauze dressing, polyurethane film, paraffin gauze dressing, silicone-coated nylon dressing, alginate dressing, hydrocolloid dressing, biosynthetic dressing, hydrogel dressing, silver-impregnated dressing) cannot be properly evaluated [19].

CONCLUSIONS

The main factor that influences mortality risk in pregnant women who suffer severe burn injuries is represented by TBSA. Fluid resuscitation in the emergent phase is crucial both in restoring the general balance, as well as stabilizing the local injury. While in superficial lesions the burn treatment in pregnant women is similar to that of non-pregnant women, in deep burns there are special considerations, in terms of treatment, to be regarded in the case of pregnant women. The incidence of burns during pregnancy remains low and proper guidelines are needed in order to find applicable treatment options that could benefit both the future mother and fetus. Although there is a number of dressings which can be used in superficial burn injuries, in the case of a pregnant woman there are emerging concerns regarding absorption and toxicity. Nonetheless, further studies are needed to be

implemented to find the best treatment options for both mother and fetus. A multidisciplinary team is needed and with a correct management plan, fa-

vorable maternal and fetal outcomes are accomplished.

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