# Prone position in pregnant woman with major burns with severe ARDS on mechanical ventilation

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**Abstract**

Burns are skin lesions determined by the thermal energy of heat transfer with cellular protein denaturation. Although infrequent during pregnancy, they can be fatal for both the mother and fetus. The outcome depends on factors related to the burns themselves, such as depth and percentage of body surface burned. Burns that affect more than 20% of the body surface can cause systemic inflammatory response syndrome (SIRS) and acute respiratory distress syndrome (ARDS) with high rates of fetal death and asphyxia. In ARDS, the prone position has been used for over 40 years to promote homogenization of stress distribution and pulmonary strain with improved ventilation/perfusion. However, pregnancy and major burns may constitute relative contraindications related to the prone position due to abdominal and pelvic compression, difficulty in monitoring fetal heartbeats and complications in face and belly burns. The set of contraindications associated with the need for the prone position guided the objective of this case report, which aimed to describe and review the literature to discuss the clinical case, as well as demonstrate the favorable results of gas exchange and ventilatory mechanics in relation to the prone position in pregnant woman with major burns without complications.

**Keywords**: Pregnancy, Burns, ARDS, Prone Position

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## Case report

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33-year-old pregnant woman at 24 weeks of gestation, body mass index of 25, cocaine and tobacco user. She was victimized by burns generated by the combustion of alcohol on 60% of the body surface, with 20% affecting the total thickness of the skin. The Abbreviated Burn Severity Index (ABSI) scored 10 points with a probability of death of up to 60%.

On the third day of hospitalization, an infiltrate with diffuse condensation was noticed on the chest X-ray and after 5 days she required endotracheal intubation and mechanical ventilation with $PaO_2/FiO_2$ ratio 236 without other organ dysfunctions. On the eleventh day, she developed Gram-negative septic shock and tracheal secretions with a $PaO_2/FiO_2$ ratio of 88 without improvement with recruitment maneuvers (Figure 1).

Thus, it was decided to use the prone position under sedation, analgesia, neuromuscular blockade and volume-controlled ventilation with a tidal volume of 6ml/Kg of predicted weight, generating a plateau pressure of 30 $cmH_2O$, driving pressure of 20 $cmH_2O$ and mechanical power 19.79 joules/minute. After 12 hours, the $PaO_2/FiO_2$ ratio increased to 242 and after 24 hours to 413 with a reduction in plateau pressure to 23 $cmH_2O$, driving pressure of 13 $cmH_2O$ and mechanical power of 14.81 joules/minute (Figure 2).

The fetal heartbeat was monitored every eight hours and remained adequate. There were no complications related to positioning or conversion of burned areas.

During hospitalization, she did not need the prone position again, the $PaO_2/FiO_2$ ratio always remained greater than 200, however she deteriorated with progressive worsening of renal function, liver failure, fevers of up to 40°C and refractory shock, which led to death in the eighteenth day.

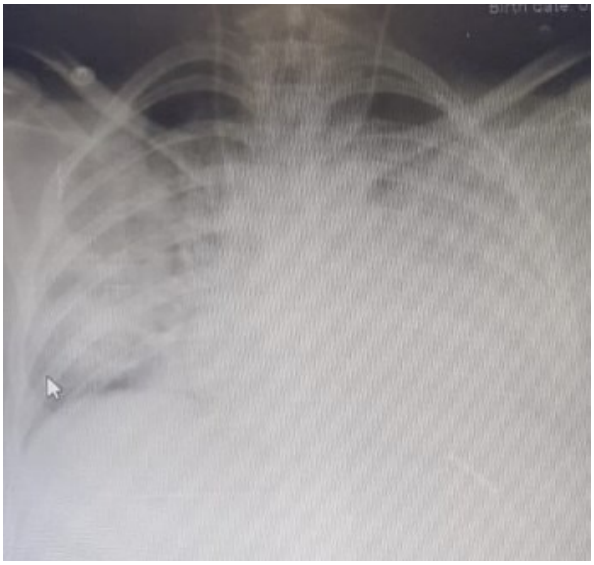

Figure 1: Antero-posterior chest x-ray before the prone position showing bilateral dense infiltrates

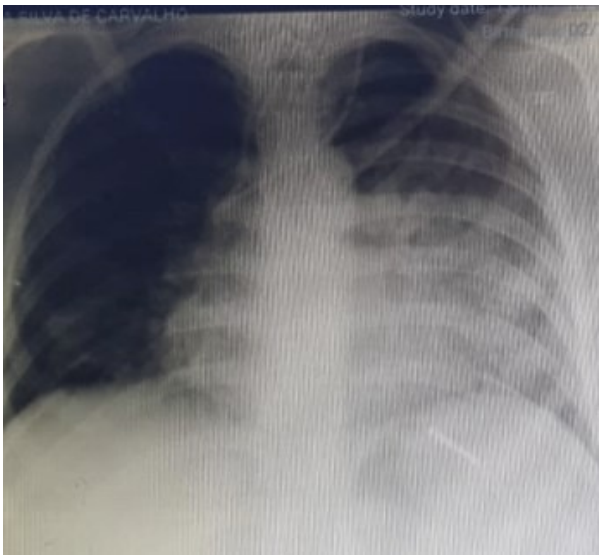

Figure 2: Antero-posterior chest x-ray 24 hours after the prone position showing improved dense infiltrates

## Discussion

Burns are skin lesions determined by the thermal energy of heat transfer capable of promoting cell protein denaturation. [1] Although infrequent during pregnancy, they can be fatal for the mother and fetus. The outcome depends on factors related to the burns themselves, such as depth and percentage of body surface burned, [2] as in this case the ABSI that pointed to a mortality rate of up to 60%, but does not consider pregnancy in its criteria.

The prone position has been used for over 40 years in patients with ARDS. [3] The prone position provides homogenization of stress distribution and pulmonary strain, in addition to improved gas exchange due to ventilation/perfusion.

The reduction in mortality is due to the decrease in alveolar hyperdistension in non-dependent lung regions and the cyclic opening and closing in dependent lung regions. [4] However, pregnancy and major burns are considered relative contraindications to the prone position. [5]

Burns that affect more than 20% of the body surface can cause SIRS, shock due to increased vascular permeability with loss of fluids and proteins with malnutrition, hypermetabolism, anemia, sepsis, [1] multiple organ dysfunction and ARDS. [6]

The estimated prevalence of ARDS in pregnancy has been reported to be 16 to 70 per 100,000, with high rates of fetal death and asphyxia. [7] Although the prevalence in pregnancy is low, extensive and deep burns favored the exacerbation of the inflammatory response and the evolution of severe ARDS.

The prone position improves oxygenation in patients with ARDS, but doubts remain about its viability and effectiveness in pregnancy. [8] Late pregnancy has been suggested as a contraindication, but adequate positioning to limit abdominal and pelvic compression and monitoring of heartbeats may allow the safe use of the prone position. [4] In healthy pregnant women at 34 weeks, it has been demonstrated that the prone position increases uterine blood flow by reducing the compression of its main blood vessels, [9] but little evidence supports the prone position in pregnant women with severe ARDS, however if maternal-fetal oxygenation is compromised, the technique seems viable at the end of pregnancy for ARDS with good results provided that its execution is meticulously planned. [10] Prone position was considered it a safe technique in SARS-CoV-2 due to sustained improvements on the $PaO_2/FiO_2$ ratio in pregnant women with a gestational age of 27 weeks. [8]

The literature points out that the use of the prone position early and for periods longer than 16 hours together with low tidal volume mechanical ventilation, leads to increased survival. [11] However the prone position faces a relative contraindication for patients with burns on the face or ventral region of the body. [12] The pregnant woman remained in the prone position for 24 hours, did not show conversion of the burned areas to deeper lesions or pressure ulcers, and the fetal heartbeat remained adequate. Regarding respiratory mechanics after 24 hours of prone position, a reduction in plateau pressure, driving pressure and mechanical power was demonstrated, with a significant increase in the $PaO_2/FiO_2$ ratio.

During pregnancy, the immune system is not suppressed, but modulated so that there are no harmful reactions from the mother's body to the fetus with differential response to various pathogens in pregnancy. [13]

ARDS eventually occurs in burned patients and the lung damage resulting from smoke inhalation is much more severe when combined with a large injured tissue area, this combination can double mortality depending on the severity of the injuries and the age of the patient. [14] In major burns, slow healing with hypermetabolism and immunological impairment are related to infections and sepsis. [15]

Major burns patients that survive the distributive shock from burns can experience septic shock as the most frequent cause of death. [16] On average, it takes 7 days for the first episode of sepsis and 54.5% of deaths from sepsis occur during the first episode of septic shock, [17] similar to this report, at the beginning pulmonary inflammation was diagnosed followed by pulmonary infection that culminated in death due to septic shock without response to culture-guided antibiotic therapy.

To our knowledge, there have been no published cases in pregnant patients with severe burns, ARDS treated in the prone position.

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