Epidemiology of Burns During Pregnancy in Southern Iran: Effect on Maternal and Fetal Outcomes

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Abstract: Burn injuries during pregnancy are considered relatively rare, but it has been reported as increasing the mortality and morbidity of both mother and infant. This study describes the epidemiology of burns during pregnancy in Southern Iran. Thirty-nine cases of burn injury during pregnancy in Southern Iran were enrolled. The patients were classified by age, total body surface area percent (TBSA%), presence or absence of inhalation injury, cause of burn, trimester of pregnancy, duration of hospital stay, history of surgery, intention of burn injury and maternal and fetal outcome. All patients had history of routine treatment and burn care protocol. The largest groups of pregnant burn patients were 21-25 and 15-20 years age groups. Flame (66.7%) was the most common cause of all burns in 39 pregnant women, followed by gas explosion (17.9%), scalds (10.2%) and low voltage electrical burn (5.1%). The extent of burn was less than 40% total body surface area percent (TBSA%) in 74.4% of patients. Average duration of hospital stay was 18.92±15.1 days. The mortality rate in the first trimester was 40.0%, second trimester, 26.3% and third trimester, 30.0%. According to the role of flame fire and suicidal attempts in increase of maternal and fetal mortality, practical reactions toward decreasing this awful event and its physical and emotional complications from responsible governors still seem mandatory. So, the most important factors to decrease maternal and fetal morbidity among pregnant women due to burn are educational programs and preventive measures.

Key words: Epidemiology · Burns · Pregnancy · Iran

INTRODUCTION

Burn injuries during pregnancy are considered relatively rare, but it has been reported as increasing the mortality and morbidity of both mother and infant. Multiple factors influence morbidity and mortality resulting from burn injuries during pregnancy and some have been shown to be independent predictors of mortality in burn victims. These factors include the depth and size of the burn, the woman's underlying health and age and the estimated gestational age of the fetus. Also, inhalation injury and development of other significant secondary complications also influence maternal and fetal outcomes [1-4].

Most of the literature has come from developing countries as the incidence of thermal accidents is high and most reports from developed countries have come before 1987 and do not reflect the current standard of care [5]. The presence of a fetus creates many special maternal physiological changes and the burn wound may place additional great stress on systems [2, 5].

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When a critically ill woman is pregnant, clinical interventions for the mother can have a profound effect on fetal status [6]. The essential principles of treatment of a burned patient are similar through pregnancy, except for some considerations about teratogenic drugs which should be fully avoided [5]. Successful burn care requires a team approach in which almost every healthcare discipline is represented [1, 6-9]. It is essential that the fetus be considered as the second patient when developing the plan of care [6].

The factors that may affect prognosis and the fetal and maternal mortality rates are related to the continuous clinical surveillance of the fetus and mother, total burn area and employing appropriate treatment protocols [10]. Banjee et al. [11] reported that emergent resuscitation and timely operative procedures may salvage a living fetus especially in patients suffering from burns including more than 60% of total body surface area.

The incidence of burn injuries during pregnancy is low. Nevertheless, burns can lead to fetal and maternal death and must be treated if substantial. Minor burns are frequently managed without any need for hospitalization [10-13]. There are several reports on using herbal drugs in healing of burn injuries [14-18]. This study described the epidemiology of burns during pregnancy in Southern Iran.

**MATERIALS AND METHODS**

From January 2003 to December 2010, thirty-nine cases of burn injury during pregnancy were treated in Ghotbedin Hospital burn center as the only specialized center for burn patients in Shiraz, South of Iran affiliated to Shiraz University of Medical Sciences. A questionnaire was prepared to collect demographic, epidemiologic and therapeutic data of all patients. The patients were classified by age, total body surface area percent (TBSA%), presence or absence of inhalation injury, cause of burn, trimester of pregnancy, duration of hospital stay, history of surgery, intention of burn injury and maternal and fetal outcome.

Burn size was determined clinically and refers to total body surface area (TBSA). Burn cause was determined by history. The diagnosis of inhalation injury was made by one of attending physicians, based on the history and physical findings. Trimester of pregnancy was estimated by last menstrual period (LMP) and obstetric ultrasonography if performed. The frequency of pregnancies and duration of hospital stays were determined using hospital charts.

All patients had history of treatment using routine burn care protocol including fluid resuscitation, topical antimicrobial agents, moist occlusive dressing and if indicated, escharotomy, debridement and skin grafting. Systemic antibiotics were used only when clinically indicated. Obstetric consultation was required without delay for each pregnant patient. All female burn patients of childbearing age with history of delay in menstrual bleeding were tested for pregnancy unless the pregnancy was obvious.

Data were analyzed using SPSS software (Version 11.5, Chicago, IL, USA). Chi-square, independent sample t and Mann-Whitney U tests were performed, as well as multiple logistic regressions to identify independent predictors of mortality. These statistical analyses were used to assess the relative predictive power of TBSA% burn, age, presence or absence of inhalation injury, trimester of pregnancy, duration of hospital stay, performance or nonperformance of surgery in hospital course and cause of burn as well as different combinations of these eight variables, as predictors of maternal and fetal mortality. The level of statistical significance was set at 0.05.

**RESULTS**

The mean age was 23.74±4.8 years (range: 16-37 years). The largest group of patients was in 21-25 (38.5%) and the least in 31-35 and 36-40 (5.1%) years old age groups, respectively. Inhalation injury was noticed more in 15-20 (54.5%) and the least in 31-35 (0.0%) years old age groups. Maternal death was mostly observed in 26-30 (55.6%) and the least in 31-35 (0.0%) years old age group. Fetal death was seen much more in 26-30 (44.4%) and the least in 31-35 (0.0%) years old age groups. Suicide was visible mostly in 26-30 (44.4%) and the least in 31-35 and 36-40 (0.0%) years old age groups (Table 1). As seen in Table 2, flame (66.7%) was the most common cause of all burns in 39 pregnant women, followed by gas explosion (17.9%), scalds (10.2%) and low voltage electrical burn (5.1%). According to Table 2, the average burn size was 38.08±26.34% (range: 8-100%). The extent of burn was less than 40% BSA in 29 out of 39 patients (74.4%) and the rest of them had burn size of more than 40% BSA (25.6%). Average duration of hospital stay was 18.92±15.1 days (range: 1-51 days).

There were 16 pregnant patients (41.0%) with inhalation injury while 11 (68.8%) of them expired. However, there was one maternal death (4.3%) in mothers without inhalation injury (p=0.001).
Table 1: Distribution of patients by age, average of total body surface area percent (TBSA%), inhalation injury, maternal death, fetal death and suicide.

<table>
<thead>
<tr>
<th>Age Groups (Years)</th>
<th>Frequency</th>
<th>Percent</th>
<th>Mean TBSA%</th>
<th>Inhalation injury No. (%)</th>
<th>Maternal death No. (%)</th>
<th>Fetal death No. (%)</th>
<th>Suicide No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-20</td>
<td>11</td>
<td>28.2</td>
<td>39.8</td>
<td>6 (54.5)</td>
<td>3 (27.3)</td>
<td>4 (36.4)</td>
<td>6 (54.5)</td>
</tr>
<tr>
<td>21-25</td>
<td>15</td>
<td>38.5</td>
<td>36.2</td>
<td>5 (33.3)</td>
<td>3 (20.0)</td>
<td>5 (33.3)</td>
<td>5 (33.3)</td>
</tr>
<tr>
<td>26-30</td>
<td>9</td>
<td>23.1</td>
<td>41.5</td>
<td>4 (44.4)</td>
<td>5 (55.6)</td>
<td>4 (44.4)</td>
<td>4 (44.4)</td>
</tr>
<tr>
<td>31-35</td>
<td>2</td>
<td>5.1</td>
<td>32.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>36-40</td>
<td>2</td>
<td>5.1</td>
<td>33.0</td>
<td>1 (50)</td>
<td>1 (50.0)</td>
<td>2 (100)</td>
<td>0.0</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>100.0</td>
<td>38.0</td>
<td>16 (41.0)</td>
<td>12 (30.8)</td>
<td>15 (38.5)</td>
<td>15 (38.5)</td>
</tr>
</tbody>
</table>

Table 2: Causes of pregnant women burns according to average total body surface area percent (TBSA%) inhalation injury, maternal death, fetal death and suicide.

<table>
<thead>
<tr>
<th>Cause</th>
<th>Frequency</th>
<th>Percent</th>
<th>Mean TBSA% (SD)</th>
<th>Inhalation injury No. (%)</th>
<th>Maternal death No. (%)</th>
<th>Fetal death No. (%)</th>
<th>Suicide No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scald</td>
<td>4</td>
<td>10.3</td>
<td>14.5 (2.8)</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Flame</td>
<td>26</td>
<td>66.7</td>
<td>44.0 (26.8)</td>
<td>14 (53.8)</td>
<td>11 (42.3)</td>
<td>13 (50.0)</td>
<td>15 (57.7)</td>
</tr>
<tr>
<td>Domestic gases</td>
<td>7</td>
<td>17.9</td>
<td>36.0 (26.1)</td>
<td>2 (28.6)</td>
<td>1 (14.3)</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Low voltage electrical burn</td>
<td>2</td>
<td>5.1</td>
<td>15.0 (4.2)</td>
<td>0.0</td>
<td>0.0</td>
<td>2 (100)</td>
<td>0.0</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>100.0</td>
<td>38.0 (26.3)</td>
<td>16 (41.0)</td>
<td>12 (30.8)</td>
<td>15 (38.5)</td>
<td>15 (38.5)</td>
</tr>
</tbody>
</table>

Table 3: Distribution of patients by total body surface area percent (TBSA%), maternal death, fetal death, inhalation injury and suicide.

<table>
<thead>
<tr>
<th>TBSA%</th>
<th>Frequency</th>
<th>Percent</th>
<th>Maternal death No. (%)</th>
<th>Fetal death No. (%)</th>
<th>Inhalation injury No. (%)</th>
<th>Suicide No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-10</td>
<td>3</td>
<td>7.7</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>11-20</td>
<td>8</td>
<td>20.5</td>
<td>0.0</td>
<td>2 (25.0)</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>21-30</td>
<td>5</td>
<td>12.8</td>
<td>0.0</td>
<td>1 (20.0)</td>
<td>0.0</td>
<td>1 (20)</td>
</tr>
<tr>
<td>31-40</td>
<td>13</td>
<td>33.3</td>
<td>3 (23.1)</td>
<td>6 (46.2)</td>
<td>6 (46.2)</td>
<td>7 (53.8)</td>
</tr>
<tr>
<td>41-50</td>
<td>3</td>
<td>7.7</td>
<td>2 (66.7)</td>
<td>2 (66.7)</td>
<td>3 (100)</td>
<td>2 (66.7)</td>
</tr>
<tr>
<td>51-60</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>61-70</td>
<td>1</td>
<td>2.6</td>
<td>1 (100)</td>
<td>1 (100)</td>
<td>1 (100)</td>
<td>1 (100)</td>
</tr>
<tr>
<td>71-80</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>81-90</td>
<td>2</td>
<td>5.1</td>
<td>2 (100)</td>
<td>2 (100)</td>
<td>2 (100)</td>
<td>2 (100)</td>
</tr>
<tr>
<td>91-100</td>
<td>4</td>
<td>10.3</td>
<td>4 (100)</td>
<td>1 (25.0)</td>
<td>4 (100)</td>
<td>2 (50)</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>100.0</td>
<td>12 (30.8)</td>
<td>15 (38.5)</td>
<td>16 (41.0)</td>
<td>15 (38.5)</td>
</tr>
</tbody>
</table>

Table 4: Distribution of patients by trimester, mean of age, total body surface area percent (TBSA%), maternal death, fetal death, inhalation injury and suicide.

<table>
<thead>
<tr>
<th>Trimester</th>
<th>Frequency</th>
<th>Mean age (Year)</th>
<th>TBSA%</th>
<th>Maternal death No. (%)</th>
<th>Fetal death No. (%)</th>
<th>Inhalation injury No. (%)</th>
<th>Suicide No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>23.5</td>
<td>44.4</td>
<td>4 (40.0)</td>
<td>6 (60.0)</td>
<td>6 (60.0)</td>
<td>5 (50.0)</td>
</tr>
<tr>
<td>2</td>
<td>19</td>
<td>23.3</td>
<td>31.1</td>
<td>5 (26.3)</td>
<td>7 (36.8)</td>
<td>6 (31.6)</td>
<td>9 (47.4)</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>24.7</td>
<td>44.9</td>
<td>3 (30.0)</td>
<td>2 (20.0)</td>
<td>4 (40.0)</td>
<td>1 (10.0)</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>23.7</td>
<td>38.0</td>
<td>12 (30.8)</td>
<td>15 (38.5)</td>
<td>16 (41.0)</td>
<td>15 (38.5)</td>
</tr>
</tbody>
</table>

There were nine fetal deaths (56.3%) in those fetuses whose mothers had inhalation injury in comparison with 26.1% of fetal deaths (6/23) without maternal inhalation injury ($p=0.05$).

Maternal death occurred in 12 of the 39 patients (30.8%). Fetal death occurred in 15 (38.5%) of the cases. All women with burns larger than 50% BSA died from their injuries, although it was not true for fetuses as 3 out of 7 fetuses (42.8%), whose mothers had more than 50% BSA burn, were rescued by emergency cesarean delivery (Table 3). The mean percentage of burned BSA among mothers who survived and died was 24.8±10.9% and 67.9±26.6%, respectively ($p=0.001$) and the mean age in these two groups was 25.0±5.06 and 20.9±2.9 years,
respectively ($p=0.004$). A statistically significant association was also found between cause of burn (flame versus burns from gas explosion, scalds and low voltage electrical burn) and maternal death [42.3% versus 7.7%, respectively, $p=0.03$, OR: 8.8 (95% CI: 1.0-78.1)] and fetal death [50.0% versus 15.4%, respectively, $p=0.03$, OR: 5.5 (95% CI: 1.0-29.8)].

The mean percentage of burned BSA among mothers whose fetuses survived and died was 33.33% and 45.67%, respectively ($p=0.15$). In 38.5% of pregnant women (15/39), the burns among the cases were due to suicidal attempts. Flame burn including kerosene or gasoline accounted for 100% of all 15 pregnant patients with self-inflicted burns.

The mortality rates in suicidal burn injuries in mothers (60.0%, 9/15) and fetuses (73.3%, 11/15) were significantly higher than the 12.5% (3/24) fatality rate in mothers [OR: 10.5 (95% CI: 2.1-51.5)] and the 16.7% (4/24) in fetuses [OR: 13.75 (95% CI: 2.8-66.0)] observed in accidental burn injuries ($p=0.004$ and $p=0.001$, respectively).

The largest quantity of burns from suicidal attempts (11) occurred in women aged 15-25 years, while the largest percentage of suicide burns among all age groups occurred in women aged 15-20 years (54.5%) and there was no suicidal attempt in women over 30 years old. The self-inflicted burn rate in the first trimester was 50% (5/10), second trimester 47.4% (9/19) and third trimester 10% (1/10).

Ten patients experienced burns during first trimester, 19 pregnant women during second trimester and 10 patients during third trimester. The mortality rate in the first trimester was 40.0% (4/10), second trimester: 26.3% (5/19) and third trimester: 30.0% (3/10) (Table 4).

Seventeen pregnant women (43.6%) were primigravid and 14 out of 39 (35.9%) underwent skin graft surgery, 10.3% (4) had skin graft surgery and dilatation and curettage (D&C) and only 3 pregnant woman (7.7%) underwent cesarean delivery. The mean time of hospital stay in alive mothers was 22.4±15.6 and in dead ones was 11.0±10.5 days, that this difference was statistically significant ($p=0.012$).

**DISCUSSION**

The possibility of pregnancy burn must be taken in consideration when any woman of reproductive age has sustained a burn. According to survey by Karimi et al. (2009), 1.3% of the burned women were pregnant [4] but in other studies up to 15% of participants were pregnant [4, 9]. Based on these significant findings, all female burn patients of childbearing age should be tested for pregnancy unless the pregnancy is obvious [2, 4, 19-24]. Early recognition of pregnancy has many benefits, including decrease the chance of teratogenic medication prescription and ionizing radiological studies [5, 9]. As soon as pregnancy is sure enough, obstetrics consult should be performed sooner in order to obtain the best outcome [2, 4, 8] and early surgical excision and skin grafting, with timely termination of pregnancy are the best lines of treatment [4, 25, 26].

In this study, flame burns were the most common burn type among the pregnant burned women. Similar findings have been reported in other studies in different socioeconomic populations [4, 19, 22, 27-29].

According to relatively high incidence of patients with suicidal behavior by burns in our region (4.3 per 100,000 and 24.8%) especially in women (6.2 per 100,000 and 71.4%) [29, 30], unique focus in this field is essential. It is more vital when we know that young married women aged 15-29 years were at greatest risk of suicidal behavior by burns [31]. Although the reasons of suicidal attempts were not mentioned in all cases; poverty, familial conflicts and addiction were shown to have a more prevalent frequency equivalent to the findings of researchers showing that the most common prevalent factor (74.4%) for suicidal behavior by burn was a quarrel with one of the family members, a relative and/or a friend [30, 31].

There was no suicidal attempt among women over 30 years old which may be due to more social and behavioral experiences in dealing with daily problems. Also, we found a direct association between burn by flame and maternal and fetal outcomes, which showed higher chance of maternal and fetal death among those who experienced burn with kerosene and in part, was originated from burn severity including size, depth and the body organ involved.

In the present study, the total maternal mortality rate was 30.8%, which was unsatisfactory but less than other parts of Iran [2, 4, 8, 26, 29] and Chama et al. report [8] and higher than other foreign reports [22, 27]. The fatality rate among pregnant women with self-inflicted burns in current research was higher than that group with accidental burn injuries (60.0% versus 12.5%), as this finding was similar to our region and other parts of Iran [2, 4, 26, 29, 30]. This difference may be originated from this fact that suicidal burn patients had higher percentage of TBSA burned (52.4%±25.8) in comparison with other group with unintentional burns (29.1%±22.8) ($p=0.006$).
The same findings were reported from previous studies performed in Iran [2, 4, 26, 29, 30]. Similar results were noticed in our study for fetuses of these mothers and suicidal attempts increased the rate of mortality when compared with fetuses of mothers burned accidentally (73.3% versus 16.7%, respectively). The study revealed that pregnancy did not adversely affect the outcome of a burned woman [2, 27, 32]. In this survey, we found that inhalation injury was significantly associated with maternal and fetal outcome after thermal injury. On the other hand, we found that it is less important than the burn size in predicting the outcome of mother and fetus, although respiratory burn had an important role.

The observed fetal mortality (38.5%) was higher than some studies [4, 7, 25] and lower than the other studies [2, 4, 26, 29]. In current study, a 50% burn was found to be critical to the finding of maternal and fetal mortality, as it was true in some other studies [4, 19, 32, 33].

In this respect, fetal risk has been shown to correspond to maternal well-being. Most fetuses survived when their mothers survived and remained free of severe complications such as sepsis, hypotension, hypoxia and death [4, 27-29, 34, 35]. We do not recommend any elective obstetric intervention in the severely burned pregnant patients unless she was in third trimester and had become significantly hypoxic, hypotensive, or septic [5]. Low voltage electrical burn (5.1%) which was seen in our study was previously confirmed in our province [36].

In conclusion, fetal and maternal prognosis is poor in severe burns and maternal and fetal survival usually parallels the percentage of burned surface area. Our survey suggested that although TBSA% burn and inhalation injury were associated with an increase in the rate of maternal and fetal mortality, the most important single predictor of mortality in pregnant women was TBSA% burn and presence of inhalation injury sits in the second position to predict mortality. Social, cultural and economic aspects may contribute to suicidal behavior and need to be addressed through real actions as education, support and obligation. According to the role of flame fire and suicidal attempts in increase of maternal and fetal mortality, practical reactions toward decreasing this awful event and its physical and emotional complications from responsible governors still seem mandatory. So the most important factors involved in decreasing maternal and fetal morbidity among pregnant women due to burn are planning for educational programs and preventive measures.

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Conflict of Interests: None declared.

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