THE AMNIOTIC MEMBRANE: A SUITABLE BIOLOGICAL DRESSING TO PREVENT INFECTION IN THERMAL BURNS

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SUMMARY: The development of wound sepsis is the most common cause of mortality and morbidity among burn patients. A variety of dressings have been used to cover, reduce burn wound sepsis and promote wound healing. The aim of this study was to compare the effectiveness of amniotic membrane with the classical method of treatment in thermal burn patients in reducing wound sepsis. Two-hundred patients, with less than 20% of total body surface, who suffered from second degree superficial and deep-thickness burns, were selected randomly and divided into two groups of 100 patients each. The first group was treated with classical method of antibiotic ointment and gauze bandage. The second group was covered with amniotic membranes procured from hepatitis-, syphilis- and HIV-seronegative mothers having undergone cesarean deliveries. The wounds were inspected for any signs of infection daily for 10 days, then on weekly basis for 4 weeks and finally monthly for 6 months. All cases were treated on an outpatient basis. In the amnion and classical methods, 2 and 17 cases of infection were respectively observed. These were hospitalized and treated successfully by debridement and administration of appropriate systemic and local antibiotics. Despite possible dangers of disease transmission, which can be overcome with appropriate precautions, we recommend the widespread use of this procedure.

Key Words: Amniotic membrane, burn, biological dressings, infection.

INTRODUCTION

Perhaps no other subject has attracted so much attention in the medical literature as the control of infection. Survival of burn patient is largely dependent upon prompt and efficient wound healing (1). This not only limits wound contracture but also reduces the incidence of wound infection. On the other hand, the primary cause of mortality among burn patients, mainly after the second week post burn, is believed to be a consequence of bacterial sepsis of wounds. The most common agents implicated are due to the resistant strains of gram negative *Pseudomonas aeruginosa* (2).

The use of various biological dressings to cover burn wounds goes back to centuries (3). A variety of techniques have been attempted in order to reduce wound sepsis, and variable results have been reported. Initially heterografts from different animal sources ranging from lizard to porcine skins were used (4). Further developments, made possible by improvement of storage techniques in the 1970s, involved the wider employment of allografts (5).

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Other attempts in the 1980s, in producing epidermal grafts were prepared from epidermal or dermal cell cultures to serve as skin substitutes (6). All these methods had limitations and variable success rates as temporary wound dressings (1). All these dressings had one major drawback of rejection of the graft, and only served as a temporary dressing. Therefore, they needed to be replaced regularly, and ultimately a permanent autograft, i.e. the patients own skin, was usually needed for deep burns. But before this is achievable, the wounds need to be primed with a neovascularized tissue for such purpose until the granulation tissues are ready for accepting the autograft (7).

Yet a more recent development in the field of control of wound sepsis is the use of a variety of occlusive and semi-occlusive artificial skin substitutes, e.g. Duo-Derm, Op-site, Biobrane, Bioclusive and others, which have undergone extensive research in recent years and reviewed by Eaglestein (8). Despite their wide use in many developed countries, none of these artificial skin substitutes serve as ideal dressings besides being very expensive, specially for routine use.

The basis for use of all of these biological and artificial skin substitutes is that they create a moist environment which has been shown to improve the rate of healing under a variety of clinical and experimental conditions (8).

The application of amniotic membrane has been suggested to serve as a suitable biological skin dressing in the 1990s (9). It has been found to be both cost-effective, speeding up the healing process, and reducing pain (10). Because of its relative ease of preparation and its low cost, we decided to implement this technique in our burn centre in Ahwaz. The main aim of this study was to investigate and test the effectiveness of amniotic membrane as a barrier to infection compared with the standard classical method used in Taleghani Burn Centre, Ahwaz.

MATERIALS AND METHODS

Preparation of the amniotic membranes

The amniotic membranes were taken from hepatitis-, syphilis- and HIV-seronegative women who underwent cesarean section in Razi Hospital, one of the university's affiliated hospitals in close proximity to our centre. The amniotic sacs were placed in sterile stainless steel containers and transferred to our centre on daily basis. The amniotic membranes were separated from the placenta, washed with 0.25% sodium hypochlorite in sterile normal saline solution using aseptic procedures, placed in another sterile container containing 500 ml of normal saline and 1 g cephalothin, and refrigerated at 4°C until needed. Microbiological tests were carried out to confirm their sterility before use. Overall the amniotic membranes were approximately 6 to 7 days old when applied to the patients.

Patients and follow up treatment protocols

Two-hundred burned patients with less than 20% of total body surface area and suffering from second degree superficial and deep-thickness thermal burns, were allocated randomly into two groups, the first (n=100) receiving conventional topical antibiotics and classical dressings, and the second (n=100) had the burn areas covered with a thin layer of amniotic membrane dressing. The patients in the second group were asked for a voluntary written consent before carrying out the proposed procedure. The ethical committee of Ahwaz University of Medical Sciences had approved this research project.

The allocation of the patients were made randomly, based on the criteria for inclusion, that is the burned areas were limited to less than 20% of total body surface area with second degree superficial and deep-thickness thermal burns. Patients suffering from chemical burns, or burned areas in sensitive parts of the body such as the genitals or face, who required hospitalization and special treatment protocols, were excluded from this study. All patients were treated on an outpatient basis. Each patient, conforming with these criteria, was randomly allocated (irrespective of age, level of education or gender) either into the first or the second group. In the control first group, the classical current procedures were used. The burn areas were cleansed with diluted povidone iodine in normal saline solution and a thick layer of nitrofurazone ointment was applied and covered with a cotton bandage. Inspection of the wounds for any possible infection was made on daily basis for up to 10 days by the plastic surgeon member of the team. In cases where infection was suspected, the patients were hospitalized for debridement of the wounds and treated with appropriate systemic and local antibiotics.

The amniotic membrane-treated group was similarly treated by cleansing of the burn wounds with diluted povidone iodine in normal saline and covered with a layer of the amniotic membrane with the amnion side down over the whole of the affected areas. The wounds were similarly inspected on

daily basis as the control group. Since the wounds were visible, the amniotic membrane was changed when necessary, that is when the integrity of the dressing was lost approximately every 3 to 4 days. In infected cases, the same procedures of inspection, debridement, antibiotic treatment and autografting, whenever necessary, were carried out.

After recovery, the patients were followed up on weekly basis for up to 4 weeks, and on monthly basis for up to six months thereafter. Any signs of infection or abnormal scar formation were recorded. In addition, the causes of the burns, age and sex profile of the patients were also recorded.

RESULTS

Among 200 cases recruited for the study, 148 (76%) were males and the remaining 52 (24%) were females. The highest prevalence was in the age group below 10 years comprising 48% of all the cases, while 24% were in the range of 11-20 years. This figure was 12 and 11% in the age group of 21-30 and 31-40 years respectively, and 5% in the above 40-year old group.

The thermal injuries were primarily caused by hot water, comprising 53% of all the cases, followed by direct flames due to gasoline, petrol or gas, with an overall incidence of 32%. Suicidal attempts were 10% and other causes were due to coal or cigarette, primarily being drug addicts, accounting for 5% of all the cases.

Two cases (aged 6 and 12) in the amniotic membrane group, and 17 cases (aged 12 to 27) in the control classical group were found to be infected and required hospitalization, and treated by wound debridement and systemic and local antibiotics. Statistical analysis, using chi-square test, revealed a highly significant difference between the amniotic membrane and control classical dressing groups with $p<0.001$. No fatality in either group was encountered. Follow ups for up to six months for both groups showed no abnormal scar formation or other complications.

DISCUSSION

The present study demonstrated that amniotic membrane was a suitable and effective biological dressing in reducing burn wound sepsis in the treatment of thermal burns among all age groups under investigation. This dressing not only lowered the hospital's and patients' costs, but also significantly reduced the rate of infection. The patients in the amniotic membrane treatment regimen required less frequent dressing change. The ease of availability of this dressing is a further advantage.

However, there are possibly inherent four main practical problems. Firstly, the need for a special arrangement and agreement between the obstetrics and the burn units. This was overcome by amicable and clear understandings between these two units.

The second problem was the need for a consent by the donors, who had to undergo tests not normally performed in the obstetrics department, that is the test for hepatitis, syphilis and HIV. These tests were carried out on the volunteers before hand on the prospective mothers-to-be who were on the elective cesarean section list.

The third problem found was the bad odour experienced by the recipients. This was a normal functional response of the amniotic membrane sloughing, and an indication for change of the dressing with a fresh one.

The fourth disadvantage may be the difficulty in accepting, among the nursing staff, to handle the amniotic membranes, because of the rumors that there is a danger of being infected with an infectious disease, such as hepatitis and AIDS. Training and explanation of the methods and the precautionary steps taken were a great help in overcoming these apprehensions.

Previous studies have shown that the use of amniotic membranes was a cost effective, even better than other allografts and heterografts and a useful temporary biological dressing (9). Further, it does not need special facilities, and can be easily employed even in small hospitals (10). The use of such material has been advocated to be used in developing countries with promising good results (11). Recently, using patching prepared from amniotic membrane has been found to be effective in the treatment of acute corneal alkali burns (12).

The mechanisms underlying the effectiveness of amniotic membrane as an aid in the treatment of burn wounds has been postulated by a number of researchers (10,13,14). In addition to its physical properties in reducing water and heat loss (10), Kim *et al.* (13) suggested that the mechanism responsible for the rapid healing observed is due to the inhibition of the proteinase activity, thus reducing the inflammatory responses by reducing the infiltration of polymorphonuclear leukocytes. Furthermore, it has been reported that

human amniotic epithelial cells do not express on their surfaces HLA-A, B, C, and DR antigens, or beta 2-microglobulin, which could further contribute to the lower inflammatory responses and relatively delayed rejection of this type of biological dressing (14).

This study demonstrated that the use of amniotic membrane as a temporary biological dressing was an effective method in reducing burn wound sepsis and we advise its wider application in other centres throughout the country.

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