

## Comparison between Hydrogel Polyurethane Foam and Standard Dressing for Treatment of Chronic Ischemic Wound

Christian Yonathan, Henry Yurianto, M. Ruksal Saleh, Karya Triko Biakto

Department of Orthopaedic and Traumatology, Faculty of Medicine, Universitas Hasanuddin, Makassar

### ABSTRACT

**Introduction.** Chronic wounds are very common and difficult to treat. One of recent methods is the application of hydrogel polyurethane foam. This study aims to compare hydrogel polyurethane foam with saline wet gauze, in the healing process of chronic ischemic wounds in rabbits.

**Materials and methods.** Ischemic chronic wounds were made to the cartilage in the left ear of 16 male rabbits. Wounds were treated with hydrogel polyurethane foam and saline wet gauze for 4 weeks.

**Results.** Chronic wounds heal with the use of hydrogel polyurethane foam in 15 samples (93.75%). While using saline wet gauze, chronic wounds heal in 13 samples (81.25 %).

**Conclusions.** Application of hydrogel polyurethane foam has clinically better result than saline wet gauze although there is not any statistically significant difference.

**Keywords:** chronic ischemic wounds, hydrogel polyurethane foam, saline

**Corresponding authors:**

Christian Yonathan, MD  
Jl. Gunung Bambapuang 2 No. 33, Makassar  
Phone : 08158809129  
Email: dr\_chrisjoy@yahoo.com

## Perbandingan Busa Hydrogel Polyurethane dengan Kasa Standar untuk Pengobatan Luka Isemik Kronis

### ABSTRAK

**Pendahuluan.** Luka kronis sering ditemui dan penanganannya cukup sulit. Salah satu metode baru adalah pemakaian busa *hydrogel polyurethane*. Penelitian ini bertujuan membandingkan penggunaan busa *hydrogel polyurethane* dengan kasa basah salin dalam proses penyembuhan luka iskemik kronis kelinci.

**Bahan dan cara kerja.** Dibuat luka iskemik kronis hingga ke tulang rawan di telinga kiri 16 belas kelinci jantan. Luka dirawat dengan busa *hydrogel polyurethane* dan kasa basah salin selama empat minggu.

**Hasil.** Pada pemakaian busa *hydrogel polyurethane* penyembuhan luka kronis ditemukan di 15 sampel (93,75%). Sementara itu, pada pemakaian kasa basah salin, luka kronis yang sembuh sebanyak 13 sampel (81,25%).

**Simpulan.** Pemakaian busa *hydrogel polyurethane* pada penyembuhan luka iskemik kronis secara klinis lebih baik dibandingkan kasa basah salin, meski secara statistik tidak ditemukan perbedaan bermakna.

**Kata kunci:** luka iskemik kronis, busa *hydrogel polyurethane*, kasa basah salin

### Introduction

Chronic wounds are common in daily practice and cause high morbidity and financial burden. Many underlying conditions may cause poor healing wounds, such as age, vascular disease, systemic disease, malnutrition and trauma medicine pressure on skin.<sup>1</sup> Ischemic is a common cause of the condition.<sup>2</sup>

Currently the animal model of chronic ischemic wounds in rabbit is closer in similarity to those in human. This model uses prolonged ischemic injury in rabbit's ear. Wound healing occurs at least after 26 days.<sup>1</sup>

Wound healing is complex and unique physiological problems. The problem may not be predictable. It is also influenced by many factors, both systemic and local. One of local factors that may provide optimal conditions for wound healing is a moist condition either in humans or animal models. Many studies have shown wound healing in a moist wound conditions is better than in dry conditions and air-exposed.<sup>3</sup>

Hydrogel polyurethane foam maintains moist wound environment, absorbs exudate, provides thermal insulation, and protects against infection. The per-unit price of hydrogel polyurethane foam tends to be more expensive. Thus, conventional wound treatment such as gauze is still commonly used in most clinical practice. However, hydrogel polyurethane foam replacement is less frequent than saline gauze. It makes the overall cost using hydrogel polyurethane will actually be cheaper. This study aims to compare hydrogel polyurethane

foam with saline wet gauze, in the healing process of chronic ischemic wounds in rabbits.

### Materials and methods

This is an experimental study using male *Lepus negricollis* rabbit. This study is conducted at Animal Laboratory of Medical Faculty of Hasanuddin University, from February to June 2012.

Samples are divided into two groups. Group A were treated by hydrogel polyurethane foam and group B with saline soaked gauze. Sample size is calculated using Federer formula, which minimal sample number of each groups are 16 samples. Rabbit was anesthetized by injection of 60 mg/kg body weight ketamine hydrochloride 5 mg/kg xylazine hydrochloride intramuscularly and also 10 mg/kg cefotaxime intramuscularly. The ears of 1 aged rabbits (weighed 3.0 - 3.5 kg) were made ischemic as described for the standard ischemic dermal ulcer model. Under sterile condition, the central and rostral nutrient arteries were divided at the base of the ear to render the ear ischemia, while preserving all three veins and the caudal artery. The skin and soft tissues were divided circumferentially down to the level of bare cartilage, thus interrupting the entire dermal circulation. Four dermal ulcers with 6 mm in diameter were created on each ear to bare cartilage by a dermal punch. Two wounds covered with a hydrogel polyurethane foam and two others with saline soaked gauze. To maintain the ischemia of tissue bed, the pedicles were re-wounded on day 5, 10, 17 and

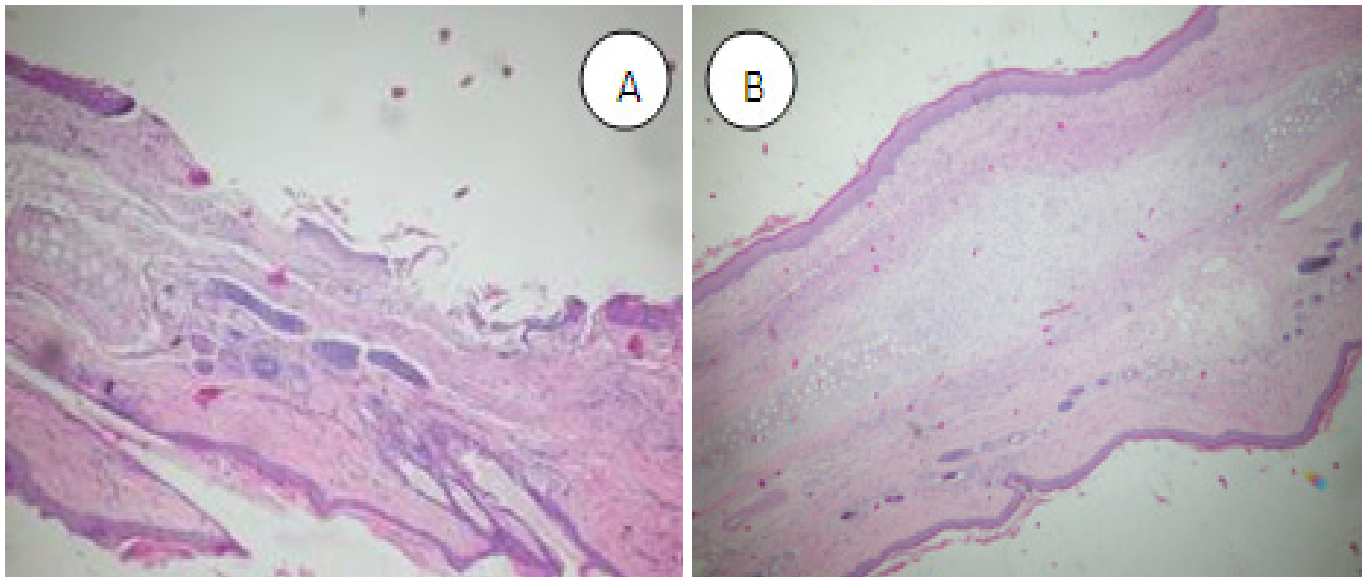


Figure 1. Histopathological finding. A. Epidermis is still open; B. Epidermis has been closed

21. The dressing would be changed every two days. All animals were sacrificed and the wounds were harvested on day 27. All animals were given food and water ad libitum and housed and maintained in a facility.

A wound healing parameter was obtained by epithelial growth (EG). These parameters have been successfully employed previously to assess wound healing in this rabbit dermal ulcer model. The wounds were excised, bisected, and then 1 half of each ulcer was fixed in 10% formalin. The tissue samples were stained with hematoxylin-eosin before examination. We evaluate wound healing by looking at epidermal tissue closure. This examination is carried out under a binocular microscope with magnification 100 and 200 times.<sup>4</sup> All data were recorded and analyzed using *Fischer's Exact test* with SPSS version 15.

### Results

Total of 32 samples were divided into two groups. Each group consists of 16 samples. Group A has epidermal closure in 15 out of 16 rabbits while group B has 13 out of 16 rabbits. The Fisher's Exact Test analysis shows no significant difference ( $p = 0.188$ ) between Group A and B.

Following pictures were taken to show the difference of healing process in both groups.

### Discussions

Chronic wounds are common, difficult to treat, leading to a high cost of wound care and decrease the quality

of life. Although many factors may cause chronic injury, ischemia is the most common cause. This study used a rabbit model of prolonged ischemic injury in the ear with minimal wound healing occurred 26 days after the wound created. Around this time, the effects of therapy can be evaluated in long period.<sup>1</sup>

Wound healing is influenced by many factors both systemic and local factors. One of the local factors that provide optimal conditions for wound healing is a moist wound conditions. Humid conditions facilitate physiological process of wound healing, the re-epithelialization and also revascularization process better than dry conditions. Hydrogel polyurethane foam has a membrane that can retain moist condition from the wound, while the saline soaked gauze moist conditions created by giving saline on gauze.

Some studies suggest that the hydrogel polyurethane foam has better results than saline soaked gauze in the healing of wounds, both in acute and chronic wounds.<sup>4,5</sup> In our study, there is no significant difference in both groups in the healing of ischemic chronic wounds.

However, wound healing is found clinically faster in Group A. In Group B, the healing is found slower due to the replacement of saline soaked gauze. The gauze was attached to the surface of wound, resulting in the destruction of the newly grown epidermal tissue and causing inhibition of wound healing.

In Group A, the foam did not adhere to the surface of the wound and the epidermal growth was not sticky to the surface of the dressing. With these conditions, re-epithe-

lialization is undisturbed and the wound healing process can be optimal. The results of the study are consistent with previous studies, which use hydrogel polyurethane foam compared to saline soaked gauze in patients with decubitus ulcer.<sup>3</sup>

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## Conclusions

Application of hydrogel polyurethane foam has clinically better result than saline wet gauze although there is not any statistically significant difference. It is necessary to have further study with larger sample size and to determine quality of the skin histologically.