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Original Article

Trial of Pilonidal Sinus Disease Induction in a Rat Model: An Animal Experimental Study

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Abstract

Introduction

Pilonidal sinus disease is a common suppurative perianal condition. The aim of this trial is to create an animal model of pilonidal sinus disease to study and compare the mechanism of action of numerous medications.

Methods

Ten adult Sprague-Dawley rats were enrolled in the study. They were separately housed in polypropylene cages. They were fed normal chow. The rats were anesthetized with Ketamine and Xylazine (At a ratio of 3:1) through intramuscular injection into their proximal thigh. The back of each rat was shaved, and a sample of the hair rat was obtained and labeled. After clearing the back of the animal, a vertical 1 cm incision was inflicted upon the dorsal side of each rat with a blade 15' and a tuft of hair composed of at least 20 fibers was embedded in the wound, later the wound was closed by 4.0 proline suture material in a simple interrupted fashion. The rats were followed for a period of 4 weeks.

Results

Macroscopically, the rats showed 0.5x0.5 cm nodules at the side of the injury at the 5th week. As there was no draining sinus, the picture in this form cannot be regarded as a typical pilonidal sinus, it was more consistent with a foreign body granuloma. No pilonidal sinus could be reported.

Conclusion

Rat is not a suitable animal for the induction of pilonidal sinus disease.

1. Introduction

Benign tumors are growths that remain localized within their primary location. They grow slowly without spreading to the surrounding local structures or distant parts of the body [1]. The cells in benign tumors appear normal and tend to stay confined to their site of origin, whereas in malignant tumors, the cells are not only abnormal but also grow uncontrollably [2]. The borders of benign tumors are generally well-defined and relatively smooth due to their slow growth [3]. Even though these lesions do not spread, they still impose a significant burden on the healthcare system. This is mainly due to their high frequency of occurrence and the need for surgical resection in certain cases [4]. Since these cells do not spread, they are generally not very

problematic. However, they can still lead to the compression of surrounding structures when they enlarge, resulting in various medical complications and pain [1]. Sometimes, a benign tumor, such as a pituitary adenoma, can grow to the point where it outgrows its own blood supply. This can be problematic, as it can lead to acute hemorrhagic infarction as well as swelling of the pituitary gland, subsequently causing visual defects like bitemporal hemianopia and ophthalmoplegia [5]. Benign tumors can also compress nervous system structures, such as the median nerve [6]. Regarding gender predominance, benign neoplasms affect both men and women equally. Despite occurring across a wide age range, they are most commonly observed in individuals aged 50 to 80 years [7]. As previously emphasized, the burden posed by these lesions is significant. In 2002 alone, it was estimated that 186,678 benign brain tumors were diagnosed worldwide [8].

As the non-operative management of PNS is growing, an animal model of PNS is necessary to test new drugs, assess their effect, analyze their mechanism of action, and report the side effects.

The aim of this trial is to create an animal model of PNS to study and compare the effects of various compounds on the disease.

2. Methods

2.1. Setting

Ten adult Sprague-Dawley rats (5 males, and 5 females, weighing between 170-220 grams and aged between 7-8 weeks) were enrolled in the study. They were separately housed in polypropylene cages at a room temperature of 22 Co (±1) with an alternating 12/12 hours day and night lighting cycle. They were fed normal chow.

2.2. Procedure

The rats were anesthetized with Ketamine and Xylazine (At a ratio of 3:1) through intramuscular injection into their proximal thigh. Following the induction of anesthesia, the back of each rat was shaved, and a sample of rat hair was obtained and labeled. After clearing the back of the animal, a vertical 1 cm incision was inflicted upon the dorsal side of each rat with a blade 15', and a tuft of hair composed of at least 20 fibers was embedded in the wound, later the wound was closed by 4.0 proline suture material in a simple interrupted fashion (Figure 1).

2.3. Follow-up and outcome measure

The rats were followed for a period of 4 weeks, during which the wounds were cleaned using Iodine every other day. The suture materials were removed on the 7th postoperative day. On the 5th postoperative week, two rats (one male and one female) were sampled. The specimens were taken from the wound and put in formaldehyde to be prepared for histological examination, and on the 6th week, the procedure was repeated for two other rats to see the progress of the disease, and finally, in the 7th week, the remaining 6 rats were sacrificed and the wounds were excised to be histologically examined for any trace of PNS.

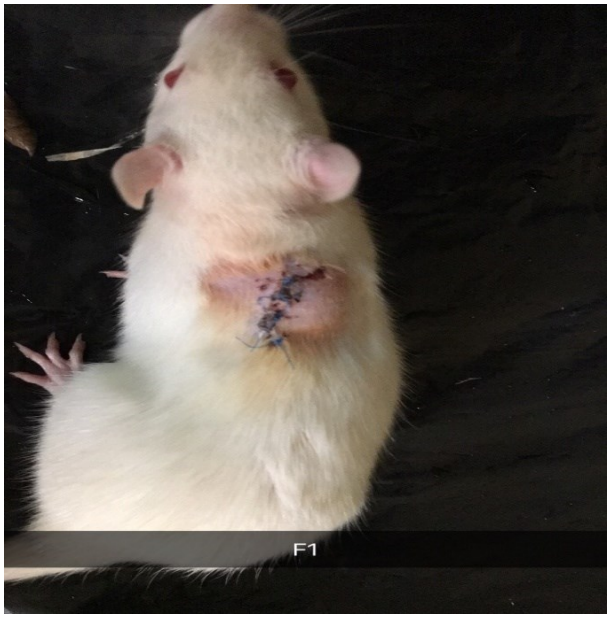

Figure 1. Incision, embedding hairs, and closure of the wound.

3. Results

Macroscopically, the rats showed 0.5x0.5 cm nodules at the side of the injury in the 5th week. The samples which were taken during the early period of the experiment (5th week) showed an intact dermis and epidermis with some degree of fibrosis, a deeply seated granuloma was seen surrounding the fragments of the hair shaft, composed of aggregates of histiocytes with giant cells (both Langhans and foreign body types) surrounded by lymphocytes and plasma cells, associated with congestion and foci of acute inflammatory changes and abscess formation (Figure 2). As there was no draining sinus, the picture was more consistent with a foreign body granuloma. No typical PNS could be reported from the trial.

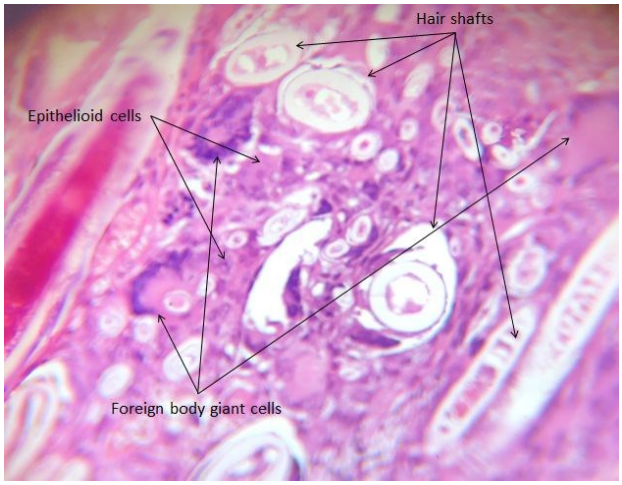

Figure 2. A deeply seated granuloma is seen surrounding the fragments of the hair shaft.

4. Discussion

One of the biggest organs in any living thing, including rats, is the skin. It is a crucial component in separating the body from

the outside world. The rat's skin does not have a morphologically uniform structure and covers the entire body surface, making up about 15% of its body weight [5]. Numerous experiments can be conducted on rats despite the structural dissimilarity between human and rat skins. Due to its functional resemblance to human skin, it makes it possible to assess the risks and benefits of suggested therapies and medications [6,7]. All mammals' skin exhibits a layered structure and has nearly a similar structure. The outermost layer of the skin, the epidermis, has an ectodermal origin. Dermis, subcutaneous adipose tissue, nerves, musculature, and vessels are all mesodermal-derived layers [5].

Ideal PNS in an animal model is crucial for understanding new medications and herbals that have recently been introduced in the literature. In a controlled randomized trial among 400 patients, Salih et al. examined the effect of a herbal mixture on PNS. They found that conservative measures with herbal preparation might have a better outcome in terms of cure, rate of recurrence, and quality of life. The mechanism of action of the mixture was not addressed and the researchers proposed further studies to understand the pharmacokinetic effect of the preparation [1].

Khan and associates, in a systematic review, found four studies analyzing the effect of platelet-rich plasma (PRP) on wound healing after the excision of PNS. They concluded that PRP was superior for wound healing in comparison to the usual daily dressing in secondary healing of PNS wounds as it shortened healing time and hastened early return to work consequently it decreased the overall cost of the treatment of the disease. The investigators could not give an explanation for the mechanism of action of PRP and other pharmacodynamic and pharmacokinetic properties as there was not enough data from the animal house and biochemical laboratories regarding the basic characteristics of the preparation [8].

This finding (nodule and foreign body granuloma) is similar to the scalp PNS in humans that has been reported in the literature [9]. The samples which were taken in the 7th week were completely normal without any sign of granulomas or nodules. This might be explained by the fact that rat is a hairy animal and has gained the capacity to get rid of hair problems.

5. Conclusion

Rat is not an ideal animal for induction of PNS. Other hairy animals may behave in the same way. Non-hairy animals might be the best option for the induction of PNS and for studying the effects of various compounds on PNS.

Declarations

Conflicts of interest: The author(s) have no conflicts of interest to disclose.

Ethical approval: Not applicable.

Patient consent (participation and publication)**:** Not applicable.

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Authors' contributions: AMS designed the study; HMR, HKM participated in preparing the manuscript; HKM participated in data collection; BAA, UAM, GSA, HA, EKM, LMA performed the data analysis; HOB, HOA, SHM, FA critically revised the manuscript; HKM, BAA confirmed the authenticity of the data; all authors approved the final version of the manuscript.

Data availability statement: Not applicable.

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