Journal of Orthopedic Practice

(ISSN: 2771-3148) *Open Access*

Research Article Volume 2 – Issue 1

Role of Topical Nitroglycerin in Preventing Keystone Flap Necrosis

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Received date: 07 February, 2022 | **Accepted date:** 21 February, 2022 | **Published date:** 24 February, 2022

Citation: Reddy KSH, Chittoria RK, Nishad K, Thomas N, Srinath R, et al. (2022) Role of Topical Nitroglycerin in Preventing Keystone Flap Necrosis. J Orthop Pract 2(1): doi https://doi.org/10.54289/JOP2200101

Abstract

In plastic and reconstructive surgery, skin flaps are widely employed. Large wounds that cannot be closed with normal treatments are treated with skin flap surgery. Skin flap necrosis is a well-known post-flap cover issue that can affect cosmetic outcomes and patient satisfaction. Variable occurrence rates and inconsistent related factors have been reported in many retrospective studies of this condition. Despite advances in technology, the rate of flap necrosis remains significant in daily procedures. Topical Nitroglycerin (NTG) has shown potential in decreasing flap necrosis in several randomized trials. In this case study, we aim to evaluate the efficacy and safety of topical NTG in preventing flap failure.

Keywords: Keystone flap failure, Necrosis, Topical Nitroglycerin.

Introduction

Skin flap necrosis is a well-known post-flap cover issue that can affect cosmetic outcomes and patient satisfaction. Variable occurrence rates and inconsistent related factors have been reported in many retrospective studies of this condition. Despite advances in technology, the rate of flap necrosis remains significant in daily procedures. Nitroglycerin relaxes vascular smooth muscle by acting as a vasodilator by producing nitric oxide **[1]**. Another well-known benefit is that it has anti-thrombotic effects. Increased blood flow to the application region is achieved by increasing the caliber of the vasculature and ensuring its patency **[2]**. Topical Nitroglycerin (NTG) has shown potential in decreasing flap necrosis in several randomized trials. In this case study, we aim to evaluate the efficacy and safety of topical NTG in preventing flap failure.

Materials and Methods

This study was conducted in the Department of Plastic surgery in a Tertiary care centre in South India. Departmental ethical clearance and consent from the subject were obtained. In this study, we have applied topical nitroglycerin (solution

form) to a 20-year-old patient (no known comorbidities) who has undergone a keystone flap to provide cover for an exposed bony surface over the right lower limb. The flap was then monitored for signs of failure on days 5,10,15 **(figure 1,2,3).**

Figure 1: Flap on Day 5

Figure 2: Flap on Day 10

Figure 3: Flap on day 15

Result

In our study, topical NTG application was successful in preventing skin flap necrosis of the keystone flap. The viability of the flap was checked by the skin colour and the flap blood sugar/normal blood sugar ratio (> 0.6).

Discussion

In plastic and reconstructive surgery, skin flaps are widely employed. Large wounds that cannot be closed with normal treatments are treated with skin flap surgery. Keystone flaps are one of the preferred options to reconstruct different types of defects, especially in the extremities. The keystone flap is different from other loco-regional flaps in that it has a great capability for adaptability. The various factors that could contribute to skin flap necrosis are age, BMI, tobacco, smoking, Diabetes, wound type and size, etc. In our patient, none of these risk factors were present hence the effect of NTG on preventing flap necrosis could be evaluated more efficiently.

A well-perfused, healthy flap will be pink, enlarged minimally in the postoperative period, and warm to the touch. Capillary refill is measured by pressing and releasing pressure on a skin paddle with a fingertip, then noting the initial pallor from direct pressure, followed by the restoration of a pink hue from reperfusion. A bluish tint, increased swelling and warmth, and a shorter capillary refill (less than 2 seconds) are all signs of a congested (venous compromised) flap. The flap will be pale in colour, cold on touch, and have a delayed capillary refill (> 3 seconds) in the case of ischemia (arterial compromised flap).

A lack of blood and oxygen to the tissue causes skin flap necrosis, which can appear anywhere from the second to the fourth day after surgery. On the leading edge of the flap, it often appears as a black patch or a blood-stained blister. Necrosis is a serious consequence that can necessitate additional surgical procedures, cause various infections, and cause treatment to be delayed. Severe ischemia, arising from obstructed artery input, causes necrosis, particularly in the flap's distal portion.

Glyceryl nitrate, commonly known as nitroglycerin, is an organic nitrate **[3]**. It's a direct topical vasodilator that comes in ointment, solution, and transdermal patch forms. It relaxes vascular smooth muscle by releasing nitric oxide, inducing intracellular cyclic guanosine monophosphate, and inhibiting myosin light chain kinase **[1]**. An increase in the calibre of arteries and veins increases blood flow to the application site **[2]**. Nitroglycerin, on the other hand, has no effect on the ratio of pre- to post-capillary resistance; net blood flow is high **[4]**. The microcirculation of the area is disrupted after flap elevation, resulting in the production of vasoactive cytokines and secondary thrombosis, eventually leading to ischemic necrosis of the flap **[5]**. Although it is known that sublingual

nitroglycerin alters vasculogenesis **[6]**. it is unknown whether topical NTG has a similar effect in a flap.

In a study by Rachel et al **[7]**. in evaluating the efficacy of topical nitroglycerin application with a reduced Mastectomy skin flap necrosis, it was concluded that nitroglycerin increases the chance of flap survival and has an excellent safety profile. When comparing thrombolytics, anticoagulants, and vasodilators in rats, Aral et al. found that only anticoagulants significantly reduce skin flap necrosis **[5]**. Cui et al. showed that dietary nitrate supplementation altered the blood flow of ischemic skin flaps in rats **[8]**.

In our study, we found that topical application of nitroglycerin is efficacious, increases the chances of flap survival, easy to use, and is cost-effective. No adverse effects after the application of nitroglycerin solution were noticed during the study. The limitation of our study is that, since this single case report study, definite conclusions cannot be made. This study can also be used as the basis for a larger prospective study to determine the efficacy of topical NTG in increasing the chances of flap survival and if nutritional interventions could optimize patients before surgery.

Conclusion

Nitroglycerin appeared to be an excellent agent for improving flap survival in skin flaps. It has a good safety profile and is thus appropriate for empirical use.

Conflicts of interest: None

Authors' contributions: All authors made contributions to the article

Availability of data and materials: Not applicable.

Financial support and sponsorship: None.

Consent for publication: Not applicable

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