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Research article

Reconstruction of perianal skin defect using modified keystone flap after perianal tumor resection

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ABSTRACT

Purpose: The large resection area of perianal tumor makes the skin defect hard to reconstruct. The keystone flap has demonstrated a growing application in skin defects. Herein, we aimed to explore the efficacy of keystone flap in the repair of skin defect after perianal tumor resection.
Methods: This study is a retrospective review of patients diagnosed with perianal tumor from January 2010 to November 2021. A standardized data collection template was used to collect variables. The detailed process of the reconstructive surgery is carefully described in this article. After surgery, the healing process was closely observed.
Results: Twenty patients underwent keystone flap repair. The average wound size before closure measured 3.5 × 4.9 cm^2. Primary wound healing was achieved, and the flap survived during the follow up period, which ranged from 6 to 24 months. No severe complications occurred; slight edema was noticed in one patient.
Conclusion: The application of keystone flap is a promising way to repair skin defect after tumor removal, and the complications rate was low after surgery. It can be concluded that this method is an effective and reliable way to repair perianal skin defect.

1. Introduction

The rarity of perianal tumor may lead to the unfamiliarity of surgeons in diagnosing and treating patients come into the clinics. The recommended wide range of resection makes the reconstruction of perianal skin defect rather difficult. The keystone design perforator island flap (KDPIF) has the advantages of easy design, sufficient blood supply, and similar color and texture to the surrounding tissue, it has been widely used in clinical practice since its first introduction [1,2]. The subcutaneous vascular network and fascial and muscular perforators support the KDPIF, the blood supply allows the application to almost any part of the body, especially large defects [3]. Herein, we report our experience with modified KDPIF in the reconstruction of perianal skin defect to achieve satisfactory outcome.

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2. Methods

2.1. Data collection

This is a retrospective review of patients admitted to our department diagnosed with perianal tumor from January 2010 to November 2021. Preoperative colonoscopy was applied for every patient admitted in our department to exclude colorectal cancer. Those accompanied by colorectal cancer were transferred to Department of Anus and Intestine Surgery or consultation was scheduled. Medical records were reviewed to retrieve patients' demographics, sizes of the lesion, treatment-related information, complications, and recurrence. Descriptive analyses were performed, and the results are presented as the mean ± SD. The Changhai Hospital, Naval Medical University granted approval for this study.

2.2. Surgical technique

In this study, we applied the KDPIFs for the reconstruction of perianal defects after tumor resection. All surgical procedures were performed under general anesthesia. The patients were placed in lithotomy position. Local excision has been a preferred option for the treatment of non-invasive tumors (Fig. 1a). Intraoperative frozen section analysis was done to confirm the clear margins and base and minimize the local recurrence rate.

The two edges of the fan-shaped flap are vertical to the curvilinear incision of the wound at both ends, the breadth of the flap is designed approximately equal to the maximal width of the wound. Besides, a V-shaped dart extension was made at the midpoint of the flap at its distal end of the wound, which had the advantage of facilitating closure, as it recruited the tissue from above and below in the vertical axis as well as in the traditional horizontal axis where tension is at its most (Fig. 1b). The KDPIF was incised along its entire perimeter. In order to preserve the integrity of the vascular perforators, blunt-tipped scissors were used to dissect vertically down to the same level of tumor resection (Fig. 1c). The dead space was closed, and wound tension was distributed by cutaneous anchoring sutures and buried sutures after advancing the flap to the appropriate site. Straticulate interrupted sutures were applied to ensure flap fixation. After the suturing, a drainage was routinely placed (Fig. 1d). The anal drainage tube was placed to avoid infection caused by excreta. Vacuum-assisted closure device was applied to the surgical area, and the maintenance of negative pressure was achieved by the InfoV. A.C. Therapy System (KCI USA, Inc., San Antonio, Texas). Postoperatively the patients were started on a liquid diet and advanced to a broader range with the return of bowel function.

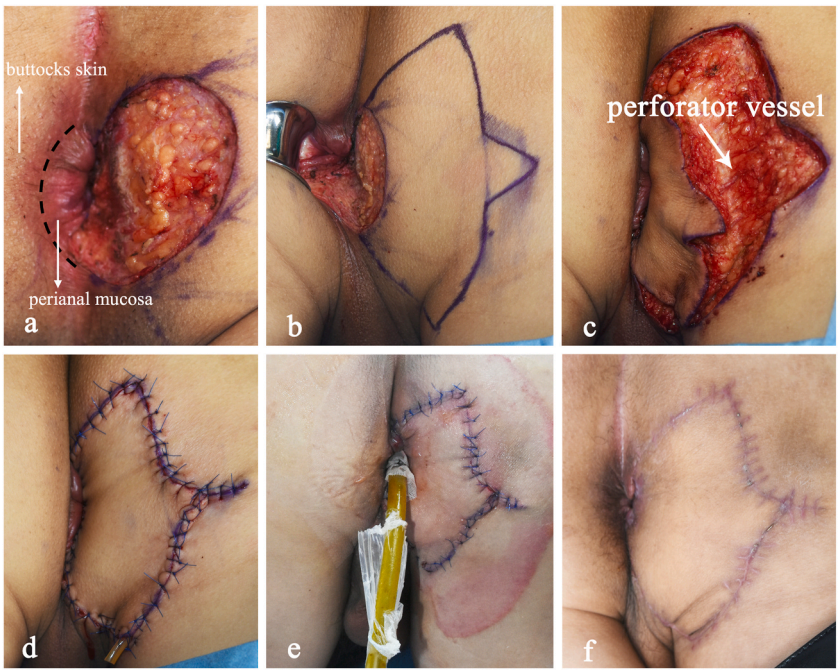

Fig. 1. Perianal Paget's disease. Typical case of the KDPIF for the reconstruction. (a). The resection area of PPD. (b). The design of KDPIF. (c). The perforator vessel of the flap. (d). Immediate after surgery, the wound was perfectly covered by the flap. (e). Seven days postoperatively, the device of NPWT was removed. The flap survived well with no necrosis and congestion. (f) Six months after surgery. The surgical wound was well-healed. No occurrence was detected.

3. Results

Twenty patients were admitted to the Department of Plastic Surgery, Changhai Hospital, Naval Medical University, Shanghai, the People's Republic of China from January 2010 to November 2021. The surgical indications for all patients were tumors in this region, including squamous cell carcinoma (SCC, eight cases), perianal Paget's disease (PDD, eight cases), epithelioides sarcoma (one cases), melanoma (one case), mucinous adenocarcinoma (one case) and trichoblastoma (one case). Three females and seventeen male patients were included. No underlying cancer and colorectal invasion were found among the included patients in our study. No recurrence occurred during follow-up period, which is 6–24 months (see Table 1).

The above illustrated design of modified keystone flap was applied in all included patients. Sutures were removed 2–3 weeks postoperatively, no severe complications like overall flap necrosis, infection, congestion, or wound dehiscence occurred in our study (Fig. 1e and f). Slight edema occurred in one patient; it subsided without any therapeutic intervention (Table 2). During the follow-up period, none of the patients showed any evidence of recurrence. Moreover, the defecation ability was normal, which indicated the function of the anus sphincter muscle was not affected. And the outcomes were very satisfying from both aesthetic and functional point of view.

4. Discussion

Our study aimed to explore the efficacy of KDPIF in repairing surgical wound after perianal tumor resection. We found that the complication rate is low and flap survival rate is high. No recurrence occurred during follow-up period. The evidence from this study suggests that KDPIF is an effective method for wound reconstruction in perianal area.

The occurrence of SCC or PDD at perianal region is rare, it describes the lesions that are located within 6 cm from the anus and below the dentate line [4]. Among the tumor we described in this article, PDD is one of the tumors that requires wide surgical excision (WLE). Surgical resection is the best curative option for PPD. Surgical treatment modalities including WLE with or without reconstruction and grafting, Mohs micrographic surgery, abdominoperineal resection [4]. The resection area recommended is 1 cm macroscopic margin beyond the lesion. However, some authors have even recommended a 3-centermeters margin, because the feature of multi-focality may be responsible for the recurrence of the disease in other area [5]. Besides, surgical excision margins of at least 0.5 cm deep into subcutaneous fat are the best recommendations [6]. However, such a large removal area may not be viable due to the intention of reserving important anatomical and functional structure. Even if the recommended area is resected, the reconstruction of the skin defect can be a difficult work to do.

Reconstructive options following WLE range from skin grafting to local advancement or rotational flaps. Myocutaneous flaps can provide excellent tissue coverage, but the tissue burden is massive compared to the resection depth. Scrotal flap is also reported to be a choice for reconstruction [7]. In our study, we chose KDPIF to achieve desired outcomes. The KDPIF was first described by Behan in 2003 [8]. It can be divided into four subtypes classically: type I is the classical and standard flap which is blunt dissected in the superficial deep fascia; type IIA requires deep fascia division; if the closure of wound will cause undue tension and require a skin graft, type IIB can be designed; type III consists of two KDPIFs and can be applied in considerably large defect; and type IV is a rotational KDPIF, its blood supplied comes from perforators in attached part. As with all the flaps, the KDPIF requires the laxity and abundance of the adjacent structure, especially type I design.

Compared with subcutaneous pedicle flaps, the KDPIF ensures better vascular supply by additionally preserving musculocutaneous and fasciocutaneous perforator vessels. This feature reduces the risks of complete flap necrosis and increases the rate of success with minor donor site morbidity [9,10]. It can be easily designed and applied when mastered. Furthermore, KDPIF can avoid differences in skin coloration and can preserve sensitivity in the region [11]. Our design of the modified KDPIF recruits the surrounding tissue to facilitate closing, and thus reduces the tension of traditional horizontal axis. With the application of negative-pressure wound therapy, which has been widely used in promoting wound healing process [12], this modifying can be applied to large skin defect to reduce complication rate and improve survival rate. Moreover, the keystone flap can be used in wound blow the dentate line.

Lack of comparison with other techniques is the limitation of our study. However, our immediate and long-term review of the included patients clearly demonstrates that KDPIF, with negligible donor site morbidity, is an effective, reliable, and durable reconstructive option for skin defect after perianal tumor resection.

Table 1
Patient demographics.

	Value
Age, yr	
Mean ± SD	64 ± 15.2
Range	28–85
Sex	
Male	17
Female	3
Size of the lesion (cm)	
(Mean ± SD) × (Mean ± SD)	(3.5 ± 2.1) × (4.9 ± 2.9)

Table 2
Keystone flap complications.

Complications	No. of flaps (%)
Minor	
Delayed healing	0 (0)
Slight edema	1 (5)
Major	
Infection	0 (0)
Flap congestion	0 (0)
Flap necrosis	0 (0)
Flap loss (particle and total)	0 (0)

5. Conclusion

The keystone flap is a simple and effective method of closing large, deep skin defects, it has high survival rate and low complication rate. Our method of applying modified KDPIF in the reconstruction of skin defect after perianal tumor resection achieves high flap viability, minimizes postoperative infection, provides surgeons with another effective approach.

Ethics approval and consent to participate

Ethics approval has been attained for Shanghai Changhai Hospital Ethics Committee, and consent to participate has been attained from the patients.

Consent for publication

The consent for publication has been obtained from the patients.

Availability of data and material

The data used during the current study are available from the corresponding author on reasonable request.

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None.

Authors' contributions

CYX and YCW designed this concept and were the major contributors to the surgical procedures. MYS, JZ and HYD analyzed and interpreted the patient data. MLW and JGX were major contributors in writing the manuscript. All authors read and approved the final manuscript.

All authors confirmed the article has not been published previously, and that it is not under consideration for publication elsewhere, in full or in part.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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