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Vertical rectus abdominis myocutaneous flap: a reconstructive option in oncological urology

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Abstract: Objective: To demonstrate the versatility of the vertical rectus abdominis flap in the reconstruction of the defects up to 25 cm. This flap provides a large volume. Clinical Case: A 72-year-old male patient with Merkel cell carcinoma in the suprapubic region and another 54-year-old male patient with scrotal squamous cell carcinoma, they are rare entities. The defects were obtained after the surgical resection, 15 cm x 10 cm and 22 cm x 11 cm respectively, using a left vertical rectus abdominis muscle flap for the reconstruction in both of the cases, with 100 % viability. Polypropylene ® mesh was used in the donor area. Conclusion: This flap is versatile and safe in the primary reconstruction of a wide range of defects in the surgical oncology, providing large volume and a long pedicle that can be adapted to the defect.

Key words: flap; myocutaneous; reconstruction; cancer; surgery

1 Introduction

The rectus abdominis myocutaneous flap was first described by Mathes and Bostwick in 1977 and later popularized by Tobin and Day; since then, it has been widely used, particularly in the reconstruction of perineal defects [1]. It is a composite flap, consisting of skin, subcutaneous tissue, and the rectus abdominis muscle; it is therefore considered a vertically oriented myocutaneous flap with the inferior epigastric artery and vein serving as its vascular pedicle [2].

The treatment of locally advanced malignant tumors of the genital and perineal regions may require extensive local resection, resulting in large defects. Many techniques have been described for performing reconstruction, and although there is no gold standard, the vertical rectus abdominis muscle flap (VRAM) represents a good option in these cases, offering acceptable advantages such as straightforward harvest, and a large volume of well-vascularized soft tissue, which allows for the coverage of defects up to 25 cm [3]; however, it should be noted that the rectus abdominis muscle, having been denervated during dissection, atrophies in the months following surgery, reducing its thickness and thus the volume of the flap. Advances in these surgical techniques and postoperative care have reduced postoperative mortality and improved long-term survival [4].

Among its disadvantages are reduced sensation in the cutaneous portion, weakness in the abdominal wall, and the formation of eventrations at the donor site [5]. McMenamin et al.[6] reported an eventration rate of 19%, and therefore recommend routine closure of the donor site with prosthetic mesh to reduce the risk.

Regarding contraindications for the use of anterior rectus abdominis flaps, a history of prior ligation of the inferior epigastric vessels during laparotomies or ostomy procedures is a contraindication, as these vessels form the pedicle that

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supplies the flap [7]. Relative contraindications include a history of hernia repairs, prior liposuction (which could reduce the flap's volume or damage the perforating vessels), and medical comorbidities such as diabetes mellitus, smoking, lymphedema, and radiation therapy, as these can impair wound healing [8].

Anatomical knowledge is essential; therefore, it is important to remember that the rectus abdominis muscle is a paired muscle located on the anterior aspect of the abdomen, lateral to the midline, and extending from the anteroinferior region of the thorax to the pubis [9].

In its upper portion, it consists of three bellies that insert as follows: a lateral belly that attaches to the lower margin of the fifth costal cartilage, a middle belly to the lower margin of the sixth costal cartilage, and a medial belly to the lower margin of the seventh costal cartilage and the xiphoid process. As it descends toward the pubis, it is interrupted by four tendinous intersections (two above the umbilicus, one at the level of the umbilicus, and one below it). Its inferior insertion is into the body of the pubis via two pillars [9].

They are surrounded by a fibrous tissue called the rectus sheath, into which the aponeuroses of the three broad muscles (external oblique, internal oblique, and transverse) converge laterally. There is a line called the arcuate line or Douglas' line, located approximately 15 cm from the pubis, which helps distinguish the structure of the rectus sheath.

Below this line, all the aponeurotic layers of the broad muscles pass in front of the rectus abdominis, so the posterior part of the sheath is represented only by the fascia transversalis.

Between the posterior surface of the muscle and the rectus sheath lies, from bottom to top, the course of the inferior epigastric artery (a branch of the external iliac artery), which runs from lateral to medial, ascending until it anastomoses with the superior epigastric artery (the terminal branch of the thoracic or internal mammary artery), which runs medial to the muscle; these vessels provide its blood supply. In addition, there are perforating vessels that traverse the rectus muscle and supply the adjacent skin; these perforators tend to be located along the medial third of the muscle and above the arcuate line [10].

To create the flap, a vertically oriented skin island is planned according to the size of the defect to be reconstructed; layered dissection is performed until the sheath of the rectus anterior muscle is reached [11]. The muscle is dissected from the posterior sheath using blunt and sharp dissection from lateral to medial; the sheath is left intact, and the skin island remains in contact with the underlying muscle. Next, the muscle is transected at its origin at the level of the costal cartilage to facilitate rotation of the flap, and the ipsilateral superior epigastric artery is ligated.

Some authors suggest leaving the attachment of the rectus abdominis to the pubic symphysis intact to prevent torsion of the pedicle [12]. In cases of a pedicled flap, the muscle is tunneled subcutaneously, ensuring that the pedicle does not undergo torsion. For reconstruction of the abdominal wall in the donor site, the literature describes many techniques, such as primary closure, component separation, and reinforcement with biological or synthetic mesh [13].

As mentioned, VRAM is preferred for reconstructing large defects; however, this procedure creates a new defect in the abdominal wall, which in turn can lead to postoperative complications [14].

The complication rate at the donor site reported in the literature is 23% according to Houdek et al. [15], 21% according to Campbell et al.[16], and 16% for postoperative complications according to Sunesen et al.[17]. Complications at the donor site include infections, fascial dehiscence, skin necrosis, and eventrations—the latter occurring in up to 19% of cases according to McMenamin et al.[6]. Therefore, among the repair options, mesh placement is recommended, especially in cases where a large flap is harvested and closure under tension is anticipated.

In the reconstruction of defects in cancer patients following pelvic and inguinal radiation therapy, the incidence of wound dehiscence can be high, given that most patients have compromised blood supply after treatment. However, the

VRAM flap is particularly useful in this scenario for preventing wound-related complications, as it has a robust blood supply.

Specific complications associated with the VRAM flap are rare; these include hematomas, dehiscences, venous congestion, and arterial and venous thrombosis. Necrosis is another much-feared complication following reconstruction, as it increases patient morbidity, prolongs the hospital stay, and leads to a poor aesthetic outcome. In this regard, the VRAM flap is highly reliable due to its good vascularization. Rates of complete flap loss of 5.1% and partial flap loss of 12% have been reported in the literature [18].

Horch et al. [19] evaluated 100 patients who underwent perineal reconstruction with VRAM flaps, finding a 6% rate of complications at the donor site and an 11% rate of flap-related complications.

In another study, Horch et al. [12] described three cases in which the VRAM flap was used for genital reconstruction: one involved vulvar melanoma, another a recurrent vulvar carcinoma, and a third case of Fournier's gangrene; only in the last case did a complication inherent to the flap occur—specifically, a hematoma—which was drained and subsequently resolved, resulting in complete healing [12].

Gordon et al. [20] reported abdominal wall reconstruction using a bilateral VRAM flap at our institution, in which no complications occurred and flap survival was 100%.

Upon reviewing the existing literature on the VRAM flap, we found a series of studies demonstrating its usefulness in a wide range of sites. We present our experience with two rare cases in the field of urologic oncology: Merkel cell carcinoma in the suprapubic region and squamous cell carcinoma of the scrotum, in which the resulting defects were reconstructed using the VRAM flap.

Merkel cell carcinoma originates in Merkel cells, which are located in the basal layer of the epidermis and perform mechanosensory functions. It accounts for less than 1% of malignant skin tumors, being more common in the head and neck and extremities, and rare in the genital region. It tends to spread locally, regionally, and at a distance; its primary treatment is surgical [21].

Scrotal carcinoma is a rare condition that primarily affects elderly patients. It has different histological variants; among the most common are: squamous cell carcinoma (32%), Paget's disease (21%), basal cell carcinoma (18%), and sarcoma (18%). The treatment of choice is surgery followed by adjuvant radiation therapy and chemotherapy [22].

2 Case 1

A 72-year-old male with a known history of diabetes mellitus and well-controlled systemic hypertension, who does not smoke, presented with a condition that had been present for approximately one year, characterized by a nodular skin lesion in the suprapubic region that progressively increased in size and subsequently ulcerated. He consulted a physician who prescribed medical treatment, but there was no improvement. Given these symptoms, he consulted a specialist who performed an incisional biopsy, which revealed squamous cell carcinoma; he was therefore referred to the Urology Department at SOH-IVSS. Physical examination: Eastern Cooperative Oncology Group (ECOG) performance status of 0. Genitals: An ulcerated lesion measuring 14 cm × 9 cm with irregular borders was observed; it was mobile and involved the suprapubic skin, the right inguinal region, part of the right scrotal skin, and the base of the penis (Figure 1). No lesion was observed on the glans; a mobile, painless right lymph node mass was present; mobile, painless left inguinal lymph node enlargements. An institutional review of the biopsy reported Merkel cell carcinoma.



Figure l. Ulcerated tumor involving the suprapubic, inguinal, and scrotal regions and the base of the penis

Extension studies were requested (chest, abdominal, and pelvic CT scan with dual contrast), which showed no involvement of the spongy or cavernous bodies of the penis, no infiltration of bony structures, a right inguinal lymph node mass without vascular infiltration, no evidence of pelvic lymphadenopathy, and no images suggestive of distant disease (liver and lung). The case was discussed at a joint meeting of the urology and plastic and reconstructive surgery departments, resulting in a diagnosis of stage III genital Merkel cell carcinoma. Oncological resection, bilateral inguinal lymph node dissection, and reconstruction using VRAM were planned and performed.

2.1 Procedure

Following oncological resection with bilateral inguinal lymph node dissection performed by the urology department, the resulting defect was measured at 15 cm × 10 cm, comprising suprapubic skin, part of the skin in the right inguinal region, penile skin, and part of the right scrotal skin (Figure 2).



Figure 2. Defect resulting from oncological resection

A left VRAM flap was created by making an elliptical skin incision in the upper two-thirds of the left hemiabdomen, measuring 15 cm high by 10 cm wide (Figure 3). The anterior aponeurosis was opened, then the rectus muscle was identified and transected at the costal margin, with ligation of the superior epigastric vessels located medial to the muscle. The flap was then dissected, preserving the pedicle corresponding to the inferior epigastric vessels, which lie lateral to the rectus muscle; a tunnel was created through a bridge of skin and subcutaneous tissue (Figure 4), and drainage and suturing of the flap were performed. The donor site of the flap was reinforced with a polypropylene mesh ®, to which a suction drain was also placed. The penile skin defect was reconstructed with a full-thickness skin graft from the left axillary region.



Figure 3. Preparation of the VRAM flap



Figure 4. Preparation of the flap

The patient remained in the Intensive Care Unit for 24 hours, progressing satisfactorily. In the immediate postoperative period, an area of epidermolysis was observed on the skin of the right inguinal region (recipient site); the area was treated on an outpatient basis, resulting in complete healing (Figure 5). No other complications were reported. Biopsy results were received, indicating Merkel cell carcinoma with neoplasm-free margins and stage IIIB metastatic right lymph node involvement. The case was discussed in a multidisciplinary meeting between the urology and plastic surgery departments, and the patient was referred for oncological radiation therapy to receive adjuvant treatment.



Figure 5. Healing of the flap

3 Case 2

A 54-year-old male with a history of well-controlled systemic hypertension and a smoking history of 20 cigarettes per day for 15 years (IPA pack-years: 15 pack-years), who presented with symptoms that had been present for approximately 6 months, characterized by an erythematous lesion on the right hemiscrotum that was progressively enlarging, followed by ulceration and swelling in the pubic hair area and in both inguinal regions, prompting the patient to consult a physician who performed an incisional biopsy, which revealed squamous cell carcinoma, leading to a referral to our center for evaluation and management.

The urology department evaluated the patient, who had an ECOG score of 0. The genital physical examination revealed enlargement of both scrotums, predominantly on the right side, associated with a 9 cm x 7 cm ulcerated lesion that was hard, with irregular edges, and extended to the skin of the penis; with no evidence of infiltration into the corpus spongiosum or corpus cavernosum. A 5 cm × 4 cm tumor was noted in the pubic hair region, with regular borders, a hard consistency, and mobility. On palpation, a mobile, ulcerated lymph node mass was palpable in the right inguinal region, and a mobile lymph node mass with signs of inflammation was palpable in the left inguinal region (Figure 6).



Figure 6. Tumor in the scrotal and pubic regions and bilateral inguinal lymph node masses

Imaging studies (chest, abdominal, and pelvic CT scan with dual contrast) ruled out a lesion originating in the penis; there was no vascular infiltration by the inguinal lymph node masses, and no evidence of metastatic disease was found. The patient was evaluated by a multidisciplinary team, which proposed a diagnosis of stage III squamous cell carcinoma of the scrotum and a surgical management plan involving oncological resection, bilateral inguinal lymph node dissection, and immediate reconstruction by the plastic surgery department using a VRAM flap.

3.1 Procedure

The urology department performed oncological resection of the tumor, which included skin from the pubic, suprapubic, scrotal, and bilateral inguinal regions, along with bilateral inguinal dissection and partial phalectomy, preserving the testicle. This resulted in a large defect measuring 22 cm × 11 cm (Figure 7).



Figure 7. Defect resulting from oncological resection

Subsequently, a left VRAM-type flap is designed, with an elliptical skin incision in the middle third of the left hemiabdomen, measuring 22 cm high by 11 cm wide (Figure 8); the flap is dissected (Figure 9); the anterior aponeurosis is opened; followed by localization of the rectus muscle, which is transected at the costal margin, with ligation of the superior epigastric vessels. The pedicle corresponding to the left inferior epigastric artery is preserved (Figure 10). The rectus abdominis myocutaneous flap was rotated toward the surgical bed of the oncological resection (Figure 11), followed by drainage and suturing. The penile defect was reconstructed with a full-thickness skin graft (Figure 12) from the left axillary region. The donor site of the flap was repaired with polypropylene mesh®, drainage, and suturing.



Figure 8. Preparation of the left VRAM flap

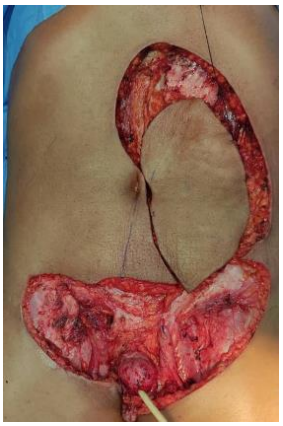


Figure 9. Flap dissection



Figure 10. The flap pedicle is identified: left inferior epigastric artery



Figure 11. Rotation of the flap



Figure 12. Full-thickness skin graft for reconstruction of a penile defect



Figure 13.Flap with good coloration and no dehiscence

The patient remained in the Intensive Care Unit for 24 hours, progressing favorably with no postoperative complications (Figure 13). Biopsy results indicate squamous cell carcinoma, with no infiltration into the penis, negative margins, and bilateral metastatic lymph node involvement; the diagnosis is squamous cell carcinoma of the scrotum, pT3 N3a M0, stage IV. The case was discussed in a multidisciplinary meeting between the urology and plastic surgery departments, and it was recommended that the patient be referred to medical oncology and radiation oncology for adjuvant treatment.

4 Discussion

The VRAM is a versatile myocutaneous flap that can be pedicled or free, making it useful for a wide range of defects.

Its excellent vascularization, the ability to harvest a large volume of donor tissue, and good cosmetic results make it one of the preferred options in reconstructive surgery.

In the resection of large inguinal, genital, and pelvic lesions, direct closure cannot be performed because it carries a higher risk of dehiscence and non-functional outcomes for the patient; therefore, the VRAM flap is a good choice [3].We present two cases involving defects in the genital, inguinal, and suprapubic areas; the first measured 15 cm × 10 cm and the second 22 cm × 11 cm.

Regarding contraindications for the use of anterior rectal abdominal flaps, a history of prior ligation of the inferior epigastric vessels during laparotomies or ostomy procedures is a contraindication, as these vessels form the pedicle that supplies the flap [7]. Relative contraindications include a history of hernia repairs, prior liposuction (which could reduce the flap's volume or damage the perforating vessels), and medical comorbidities such as diabetes mellitus, smoking, lymphedema, and radiation therapy, as these can impair wound healing [8]. One of our patients has a diagnosis of diabetes mellitus and the other is a smoker; however, these are not absolute contraindications, and we achieved good wound healing.

The rate of donor-site complications reported in the literature is 23% according to Houdek et al. [15] and 16% according to Sunesen et al. [17]. Donor-site complications include infections, fascia dehiscence, skin necrosis, and hernias—the latter occurring in up to 19% of cases according to McMenamin et al. [6], for which the use of prosthetic material is recommended. In the cases we report, the patients did not experience any donor-site complications; in both cases, we used polypropylene mesh.

Flap necrosis is a much-feared complication following reconstruction, as it increases patient morbidity, prolongs the hospital stay, and leads to a poor aesthetic outcome. In this regard, the VRAM flap is highly reliable due to its good vascularization. Rates of complete flap loss of 5.1% and partial flap loss of 12% have been reported in the literature [18]. The two patients presented in our study had 100% flap viability; in one of the patients, epidermolysis was reported in the skin of the inguinal region, but not in the flap.

The VRAM flap is versatile and safe for the primary reconstruction of a wide range of defects in surgical oncology, providing a large volume and a long pedicle that can be adapted to the defect. Since it is vascularized by the inferior epigastric artery, it receives excellent blood flow, making flap necrosis rare. The use of prosthetic material is recommended to prevent the risk of eventration in the donor site.

For all these reasons, the vertical rectus abdominis myocutaneous flap is an excellent reconstructive option for defects in the suprapubic, genital, and inguinal regions, offering a large donor volume, as seen in the two cases reported.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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