
Resuscitation Foot Necrosis: A New Entity for a Complex Management?

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Contents

13.1	Introduction	89
13.2	Clinical Presentation	90
13.3	The Therapeutic Decision	90
13.3.1	Evolution.....	90
13.3.2	The Strategy Concerning the Therapeutic Attitude	90
13.3.3	Surgical Intervention.....	92
13.3.4	Follow-Up.....	93
	Conclusion	94
	Bibliography	94

13.1 Introduction

As in every medical discipline, resuscitation techniques are regularly progressing, allowing more and more patients to survive. In these departments, acute skin problems are observed, particularly those linked to the use of vasopressive drugs prescribed to maintain a stable patient haemodynamics. Once the acute phase is solved and the patients are stabilised, the consequence of the use of these vasopressive drugs may appear and become the main difficult problem. The context is variable, but most of these patients have presented or still present with prolonged haemodynamic shocks (septic shock, purpura fulminans, etc.) [1].

Since the last decade, we have been confronted with a series of patients presenting with skin and tissular distal extremities necrosis following intensive care. Problems were essentially involving the hands and feet. This new capacity of resuscitating desperate life-threatening situations in patients who already died creates a series of new challenging tissular reconstruction. The management of these patients is delicate in terms of the therapeutic decisions (amputation or limb salvage) but also of the OR planning and modalities. We hereby propose action to be taken and the elements of management which have shown to be important in view of our clinical experience.

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13.2 Clinical Presentation

This dry necrosis has probably evolved from the superficial to the deep structures. The whole skin and subcutaneous tissues may be affected (skin, subcutaneous cellular tissue, muscles). The damage is essentially located at the level of the toes but also involves the plantar vault leaving intact the calcaneal area, a sign of pejorative evolution.

Lesions appearing on the dorsal aspect of the foot are usually less extended than on the plantar aspect and appear secondarily. The pathophysiology is linked to vasoconstriction (linked to amines) potentialised by the existence of a haemodynamic failure already present in these patients. This drop in blood flow linked to vasoconstriction may lead to small-diameter vessel thrombosis explaining the clinical situation: necrosis from superficial to deep toe necrosis with thrombosis of the collateral arteries.

13.3 The Therapeutic Decision

13.3.1 Evolution

The choices made during the surgical debridement procedure should be carefully balanced because of their impact on the whole success. This decision must be made in careful consultation with the critical care team. The evolution of this necrosis is different to those found in arterial patients. In fact, intensive care patients are often young and do not present with preliminary vascular lesions or permanent heart failure. The vascular injury observed in resuscitation is therefore an epiphenomenon, and the improvement of the haemodynamic status associated with the limitation of vasopressive drug administration will sometimes allow the partial recovery of tissue which initially appeared as destroyed. Also in Fig. 13.1, this patient presents with an extremely disturbing situation of the foot arch and for which we observed a complete or partial tissue recovery (with the disappearance of the shock associated with the suppression of amines). The necrosis was limited to the superficial part of the cutane-



Fig. 13.1 Initial state of a patient still taking vasopressive drugs

ous tissue; the toes could not be saved. There is therefore a real danger in planning a surgical procedure before the patient is in a completely stable status. In our experience, the surgical procedure started 15 days at the earliest after the stabilisation of the clinical status and the suppression of amines. An earlier debridement can conduce to excise tissue with uncertain evolution. This is equally true of a certain number of intensive care specialists who ‘push’ to debridement partly because the fever presented by the patients may be linked to necrotic tissue (Fig. 13.2).

13.3.2 The Strategy Concerning the Therapeutic Attitude

The therapeutic decision is complex and does not comply with the established decision tree. It mainly depends on the experience of the



Fig. 13.2 Evolution 3 weeks after and the stopping of vasoactive drugs and amputation of the toes

practitioner, but the final decision often comes from the patient himself.

We exclude the situations relying on classical techniques of healing (skin graft, treatment by negative pressure, etc.). We have limited ourselves to the most serious situations where the only solution is to perform a free flap to avoid the amputation of the leg [2]. Situations exist where all attempts at salvage are excluded due to the clinical situation: necrosis affecting the entire foot (plantar side, dorsal side, and heel cup) and especially when the necrosis reaches the proximal aspect of the ankle (Fig. 13.3), the contraindications to microsurgery (arterial patient, heart failure, renal failure...) and a patient who has no donor site (latissimus dorsi muscle). When a solution seems conceivable, the patient must be seen awake and the therapeutic stake must be clearly explained, as well as the risks of amputation, in case of failure. These patients should be in



Fig. 13.3 A young boy 6 years of age presenting with necrosis of 2 ft going up to the ankle. Surgical exploration having confirmed this extensive necrosis with notable necrosis in the two ankle bones, no solution has unfortunately been envisioned

complete physiological and mental recovery, and this decision does not need to be taken urgently. It is also necessary to see the patient several times to be sure that the situation and the potential complications are completely understood. Of course, all the elements will be taken into account in the therapeutic option (age, professional activity, uni- or bilateral injury...). As in many of these difficult decision-making moments, care must be taken to avoid increasing the number of people involved as this makes the decision process more complicated for the patient. Nevertheless, we ask a rehabilitation doctor specialised in limb prostheses to visit the patient, so that the patient has a complete picture of the problems. The options can be simplified to salvage or amputation of one or more limbs or parts of the limbs. The objective is saving the foot but toes were usually not be saved. The aim is therefore to anticipate a back to normal walking. However, running will definitively be compromised.

The salvage require a microsurgical muscle transfer. Usually the latissimus dorsi muscle is used (isolated or associated with the dental mus-

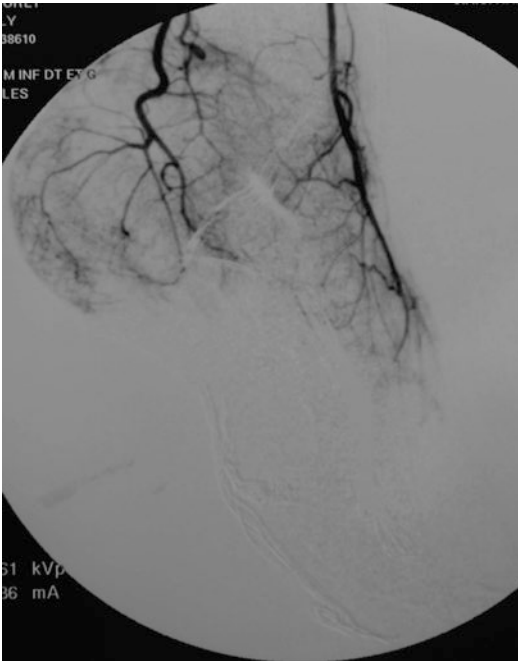


Fig. 13.4 Arteriogram of a 42-year-old patient presenting with a 'resuscitation foot' with a clear interruption of the flow and a desert afterwards

cle) to cover this large loss of substance. The choice of muscle (versus cutaneous flap) is fundamental. This choice remains controversial [3], but for us, it will be the only way to fill the dead space volume after debridement, the only way to be sufficiently thick to ensure a secondary support and avoid the soaping phenomenon, and it is the best way to reduce the risk of infection. In addition, we think that the blood reserve that represents the muscle allows debridement to be limited because certain undefined tissue limits may benefit the vascular supply brought locally by the revascularised muscle. The only negative in this strategy is the sacrifice of the latissimus dorsi muscle which may be detrimental if the intervention fails, and the use of crutches proves to be necessary.

If the decision is taken, a vascular assessment is performed in order to explore the arteries of the lower limbs. The choice of an arteriogram or an echo/Doppler with a flux calculation may be performed. The arteriogram usually shows a clear interruption of the arteries with a healthy network before and a vascular desert after (Fig. 13.4).



Fig. 13.5 A 42-year-old patient presenting with necrosis of almost all of the instep following a visit in rehabilitation for septic shock and the use of vasoconstrictive drugs



Fig. 13.6 The foot of the same patient after the surgical debridement (we may note that the heel cup is partially preserved, which is often the case), the debridement is not exhaustive, and certain tissues have uncertain vitality but are left in place because we hope for a certain part of 'revascularisation' contributed from the free flap

13.3.3 Surgical Intervention

Debridement and free flap will be performed during the same operation. Debridement must remove all the necrotic tissue but must try to leave in place the tissue which is in doubt or especially limit the bone structures for the reasons explained earlier. The flap specimen will only be started (by a second team if possible) once the debridement has been performed and the salvage indication has been confirmed (Figs. 13.5 and 13.6). The vessels must be addressed in a healthy zone. On the strategic plan, it is necessary to expect an option for covering pedicle anastomoses of the free flap because

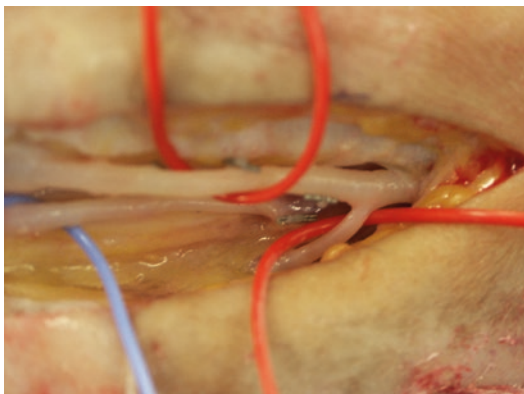


Fig. 13.7 Expose the vessels of the patient; these appear healthy during the surgical exploration

complete debridement does not offer any option of covering the remaining tissue on the foot. For these, the Z incisions (allowing a V/Y closure) are made opposite to the recipient vessels. In addition, the entire latissimus dorsi is removed (level with the tendinous insertion). The high part of the muscle may also be redriven over the vessels after anastomosis completion in order to cover them.

The recipient vessels have always been of good quality, in our experience (Fig. 13.7), because it concerns a young patient with no mechanical avulsion and trauma. The limit between the healthy and pathological zone is actually extremely clean. Technically, this microsurgical act does not at all differ from the standard free flap. During the follow-up period, we apply the normal protocols: fasting during 12 h in case it is necessary to perform further surgery, bed rest for 5 days, and regular monitoring of the flap. The dermo-epidermal skin graft on the muscle is performed between the 5th and 8th day associated with the restructuring of the flap.

13.3.4 Follow-Up

When complete healing of the flap has been achieved, it is necessary to be sure of its very bulky aspect and especially its temporary characteristics (Fig. 13.8). Volume reduction will take place progressively and may require between 2 and 6 months (Fig. 13.9).



Fig. 13.8 The flap is put in place and grafted 15 days after the intervention. Its bulky appearance is only temporary



Fig. 13.9 The result at 4 months with slight decrease in the size of the flap allowing a normal walking for the foot supported by adapted shoe inserts

Compression stockings are applied 21 days after the surgical intervention as well as when leaving the rehabilitation centre where walking will be gradually recommenced.

Patients are seen every 3 months then every 6 months; often there are inflammation episodes which translate into an inflamed pressure, most often on a fragment of necrotic bone. Surgical action must be done sparingly. Usually walking limitation by a 10-day course of antibiotics allows the problem to be resolved. Sometimes the radiographic assessment highlights a bony fragment potentially in relation with the clinical signs. A surgical excision may then be suggested, preferably conducted by the same physician who performed the free flap. We would not cover all aspects of rehabilitation here (learning to walk again, shoes and adapted shoe inserts, etc.) which remain a fundamental part of the patient learning to walk normally again.

Conclusion

The advancement in resuscitation has led to the appearance of a new type of pathology that we commonly call 'pied de réanimation'. It refers to a necrosis of all or part of the foot (and sometimes other extremities) by a phenomenon resulting from a combination of haemodynamic shock and the use of vasopressive drugs in high doses.

These necroses are often major and the challenge for the plastic surgeon to envisage the possibilities of 'limb salvage'. This is done via the execution of a large-sized muscular free flap (still the latissimus dorsi) in our experience. This surgery presents an increased failure rate than the usual rate of failure but a 77 % success rate is still acceptable.

The follow-up of patients nevertheless shows a large majority who are able to walk, enjoy leisure activities, and live a normal life, and this pushes us to continue this method of treatment (Figs. 13.7 and 13.8).

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