

Extremity amputation: how to face challenging problems in a precarious environment

Sylvain Rigal

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Abstract

Purpose Indications for amputation in natural disasters are not the same compared to our daily practice. They must be determined by those with great surgical experience and good knowledge of military or disaster surgical doctrine. Unfortunately, nowadays few surgeons have this experience. In fact, some volunteer surgeons may be interested in providing care for civilian victims of war or disaster in developing countries. However, there are significant differences between the type and the management of cases seen in this context versus those seen at home. The problems of amputations cannot be solved schematically. Amputation will depend on several factors: the form of warfare or disaster, the conditions for surgery, the skill of the surgical team and the experience of the surgeon, and the length or duration of the mission.

Methods Here is a schematic showing the three main situations: civilian practice, war practice and disaster context. These three different situations require different strategies for treating the wounded and for making amputation decisions.

Results In the case of a natural disaster, there are many wounded civilians, they arrive at the medical facility late and there is usually only one surgeon and a single, limited

medical facility to provide all treatment. He must make quick, wise choices, economising limited blood supplies and the use of surgical procedures. The decision to proceed with limb salvage or amputation for patients with severely injured limbs will be a source of continued debate. Amputation, radical and irreversible intervention, is a frequent and essential procedure in the disaster context and one of the standard means to successful treatment of limb wounds.

Conclusions We propose to reflect on the following questions: why to amputate, how to perform amputation under these conditions and how to pass on a doctrine to the voluntary surgeons who lack experience in a disaster context.

Aller où la patrie et l'humanité vous appellent et soyez toujours près à servir l'une et l'autre [1]

Baron Pierre François Percy (1754–1825), Surgeon General of Napoleon's Grande Armée.

S. Rigal
Clinic of Traumatology and Orthopaedics, Percy Military Hospital,
Clamart, France

S. Rigal
Department of Surgery, French Military Medical Academy,
École du Val-de-Grâce,
Paris, France

S. Rigal (✉)
Service de chirurgie orthopédique, traumatologie et chirurgie
réparatrice des membres,
101 avenue Henri Barbusse,
92140 Clamart, France
e-mail: sylvainrigal@me.com

Introduction

In disaster situations (characterised by inadequate resources and extensive needs), surgeons face significant human and ethical problems. Under these dramatic conditions, when dealing with serious injuries of the limbs, amputation is always a difficult decision, but often the most appropriate.

Amputation is a radical and irreversible intervention. The decision to proceed with limb salvage or amputation of severely injured limbs will always be a source of continuous debate. This judgment decision should be made by surgeons with great surgical experience and good knowledge of military or disaster surgical doctrine.

Unfortunately it is rarely the case, since few surgeons have this experience.

The goal of this presentation is to provide a brief overview of the principles and practical aspects of surgical response to limb wounds in major natural disasters. Our purpose is to assist the reader in establishing reasonable goals when confronted with the question of limb salvage versus amputation, but with great humility. This field requires one to adapt to the unique constraints of each situation, acting in a wide variety of circumstances which call more often for flexibility than for “improvisation” as named by O’Keeffe [2]

Major amputee care decision landmarks

In an austere environment the indications for amputation are not the same compared with daily practice. In fact, some volunteer surgeons may be interested in providing care for civilian victims of war or disaster in developing countries. However, there are significant differences between the type and the management of cases seen in this context versus those seen at home [3].

The French army medical service is frequently engaged in treating service men or civilians injured in armed conflict and in catastrophic natural disasters. Our surgical teams have experience from many military and humanitarian missions.

In our opinion, strategies of surgical treatment of wounds are different in military and in disaster relief situations. The standard military wound treatment is not always the best in a disaster situation. However, there are plenty of commonalities between these two practices that share many methods and principles. Only a good knowledge of the two situations allows us to take the right decision.

The problems of amputations cannot be solved schematically. The decision to amputate in normal practice is always difficult, even when the environment is “comfortable”. Amputation, in the disaster context, will depend on several factors: the form of warfare or disaster, the conditions for surgery, the skill of the surgical team, the experience of the surgeon and the duration of the mission.

It is all the more difficult when a surgeon is removed from his normal environment and familiar routines and is injected into a crisis where he faces the unknown. At the same time, this context demands a higher level of excellence, because one is treating a fragile population in a vulnerable state.

This article is a reflection on the necessity of giving surgeons both ethical and practical preparation, in order to enable them to make rational choices when amputation is an option.

Surgeon’s specific practices in an austere environment

There are three main situations facing a French army surgeon, each one requiring a different response:

- In their regular civilian practice (the normal training for surgeons who will be deployed), evacuation of the wounded is often rapid. There are many surgeons for a single patient. Hospitals are well equipped, and treatment continues without any limitation of time within a multidisciplinary based decision frame providing the most appropriate care for amputees.
- Under battlefield conditions, for military wounded, care starts at the time the wound occurs, with a combination of highly capable field medics, forward area resuscitation, and rapid and sophisticated medical evacuation [4, 5]. The forward surgical team has limited resources and personnel. The goals for initial care are to preserve life, prepare the patient’s evacuation and leave the maximum number of options open for definitive treatment [6]. The concept of “damage control orthopaedics” meant to optimise care in minimal time applies [7]. The wounded are rapidly air evacuated to a hospital, often in a developed country. In our practice a French soldier wounded in Afghanistan is usually transferred within 24 h to the Percy Military Hospital in Paris.

For civilian wounded treated by military surgeons, the situation is different. Here, all treatment must be carried out in the hospital on the ground with no possibility of evacuation. This situation is often the same for civilians in a disaster context.

- In case of catastrophic natural disasters: Natural disasters not only cause loss of life, they also damage the infrastructure and the economic backbone of a society [5]. Local health care is severely disrupted [8]. Early care is rather rare and is only possible if structures are not too severely damaged and there are means of evacuation (such as Duman et al.’s [9] experience during the earthquake in Turkey in 1999). In these rare circumstances amputation remains more limited.

In many cases the wounded civilians arrive at the medical facility late and without professional evacuation [10]. The surgical team is always deployed later in disaster areas. The longer time period between the injury and the treatment requires management changes. There is usually only limited surgical staff and material and a single, limited medical facility to provide treatment. Consequently, when a large number of wounded arrive simultaneously, each cannot be treated in an optimal period of time. Delayed treatment can decrease success rates, and patients suffering from multiple injuries face considerably reduced chances of survival.

These three different situations require different strategies for treating the wounded and for making amputation decisions.

Strategies for amputation in disaster conditions

The surgeon is not always familiar with the practice of humanitarian missions, specifically in an austere environment with very little equipment, limited communication and few resources. He is often confronted with unusual injuries at advanced stages, especially with regard to infection. He must assume complete responsibility from the reception of the patient until his rehabilitation. Sometimes the local medical facilities, often destroyed, do not allow the surgeon to provide the full treatment that conservative medical practice would normally require. He must accept the lack of resources and try to do the best he can with what exists [2]. He has to define treatment priorities when faced with a large number of wounded. He must make quick, wise choices, in order to save limited blood supply and the use of surgical equipment. It is clear that most surgeons have not faced these kinds of injuries or situations during training or regular practice. The following could prepare them to deal with many patients facing limb salvage or amputation.

The inexperienced surgeons should be prepared in advance to respond to the following questions. Why is amputation so frequent in a disaster context, and how to perform amputations under these conditions?

Amputation is a frequent and essential procedure in the context of a disaster and one of the standard means of successfully treating arm and leg wounds. Surgeons should focus their attention on stopping and preventing haemorrhage, debriding wounds to prevent infection and preserving function.

First scenario: to save the limb is impossible in cases of grave injury, then amputation is necessary.

Second scenario: to save the life requires the loss of the limb [11]. Amputation is retained for general reasons that involve the life of the wounded. The surgeon must balance the realistic likelihood of the ultimate reconstruction of a functional extremity against the risk of the death associated with attempts to preserve a limb [6]. In a haemodynamically unstable patient, the amputation may be necessary to save his life. In this situation, saving the patient's life always takes priority over saving the limb. Sometimes, the amputation is done as a life-saving procedure. The amputation becomes a form of damage control surgery.

Third scenario: the most difficult choice is when retaining the limb is possible, but where amputation actually allows the surgeon to preserve the patient's capability.

Amputation must be compared to complex reconstructions that include soft tissue loss and a complex fracture, where there is a high incidence of contamination with resistant

bacteria. When a patient has had an infection in an ischaemic limb, the risk of recurrent infection and sepsis is far lower when the limb is removed than when it is retained [12]. For patients with severe injury of the lower extremity reconstruction involves a higher complication risk [10], additional surgical procedures and more hospital readmission.

It was long ago emphasised, during Napoleon's campaigns, by the surgeon of the Grande Armée Jean François Percy [13]. «*L'amputation doit être un ultimatum, que l'habitude difficile du pronostic a seule le droit d'avancer ou de retarder. Au reste, on est malheureusement dans plus d'une circonstance, obliger de couper un membre que le repos, une bonne situation et la réunion de tous les avantages qu'on rencontre dans un hôpital, eussent peut être réussi à conserver*».

“Amputation has to be the ultimate decision. Only a very experienced surgeon with a large amount of practice has the right to move forward or to delay. Unfortunately, we are often in circumstances that oblige us to amputate a limb, while in more favourable medical circumstances, we could have managed to preserve it”.

With advances in both vascular and orthopaedic reconstructive surgery, limb salvage has frequently become an option for limbs that would previously have been amputated. Conservation of the limb might be technically possible but it is not always the best solution. Scoring systems in the treatment of mangled extremities do not seem to us applicable under disaster conditions, as in war [14]. Numbers cannot replace clinical judgment, in regular civilian practice [15, 16]. Operator experience is thought to be the most important factor [7]. As noted by Griffiths and Clasper [7] and Clasper [14] in war surgery, it would be even recommended in a disaster environment to have a second opinion before deciding on an amputation.

We always consider if the patient and his family can afford the multiple operations and have the necessary time for the full treatment. For some injuries, the patient does not want to endure prolonged, staged salvage attempts. An amputation is a viable alternative.

Fourth scenario: there may be circumstances when many seriously wounded need to be treated rapidly. This can lead the surgeon to perform amputation because this can be done much more quickly than limb salvage. Amputation can be a choice required in a situation with mass casualties. That requires an important change in the surgeon's professional mindset. He must understand the situation far in advance, in order to be prepared. It is necessary for him to understand the reasons and the choices for the amputation in these circumstances. The logic followed must be “the best for the most” and not “everything for everyone” [17]. This means that amputation is no longer an individual decision. Most of the army or civilian support hospitals have enough equipment to perform multiple simultaneous surgical procedures. Amputation is a faster, safer

procedure that must be considered in situations with mass casualties, as an action of collective damage control. The surgeon can assure a more proper outcome and appropriate use of resources [15].

Tactical considerations

Standard protocols are necessary. Correct surgery gives the patient the best chance of survival with a good quality of life and shortens the stay in the hospital. A disaster situation requires that one adapts the behaviour normally proposed by military health services or nongovernmental organizations in war. In the military context, the current rule is to amputate as conservatively as possible in viable tissues. The final level of amputation and definitive treatment will take place after evacuation in a stable environment, and not in the combat zone hospital. An “open length preserving amputation” [2] completes the amputation at the lowest possible level of bone. The soft tissues distally should be preserved to be used in the subsequent closure of the amputation stump. These flaps of opportunity can add length to the stump.

In a natural catastrophe, the technique is dictated by the need to maximise the use of the operating room. The first option is an initial procedure which should be as decisive as possible. The unique gesture with primary closure carries a huge risk of infection. The result of this amputation is a more proximal section in healthy tissues.

The second option is amputation conducted with at least two procedures. The goal is to achieve amputation as quickly as possible, with the aim of avoiding infectious complications. Primary amputation of a limb may be required as a part of the initial débridement, which should be performed in healthy tissue in order to eliminate the need for additional trimming later. It is a semi-definitive amputation, but left open. The second procedure will complete the operation.

The International Committee of the Red Cross experience regarding war wounds certainly should be retained in the context of a natural disaster. Most patients require two operations: débridement and delayed primary closure. More than two usually denotes a complication, typically sepsis [17].

However, the open circular method also called “guillotine amputation” should not be performed. It is defined as skin, soft tissue and bone all cut at the same anatomical level using a circumferential skin cut. This procedure sacrifices the length of the limb and makes prosthetic fitting more difficult. Guillotine amputation is not significantly quicker than an amputation excising nonviable tissue and foreign material if flaps are not fashioned during the primary amputation [14].

Finally, two options are acceptable. A definitive amputation in the immediate area of totally healthy tissue resulting in a closed stump. But the result of amputation is at a more

proximal location to remain within healthy tissues. A two-stage operation entails a distal incision in healthy tissue and the creation of the stump after four or five days [3].

Educational programme

Ryan [18] underlines, from his experience with surgery in catastrophe conditions, the necessity of deploying only an experienced, trained staff. That is also for us an absolute imperative.

Our aim is to teach surgery in an austere environment for ethical, moral reasons and efficiency purposes. Despite the difficulty of communicating rare experiences or situations, it is essential to provide a basic knowledge about the specificities of practising in disaster situations.

Specialist training and sophisticated modern technology in a peacetime environment is not appropriate to the surgical demands of a disaster context, and clinging to standard procedures can be an obstacle to success in precarious environments.

The French university training is more and more specialised and does not transfer to the specific surgical needs of a war or a catastrophe.

One cannot understand battlefield surgery working in a trauma centre. Similarly, one does not learn all humanitarian surgery from the practice of military surgery.

There stands the greatest challenge because there is no practical training field. A robust educational programme is a fundamental component of the military treatment facilities. In the French army medical service, an accredited teaching programme exists within medical teaching facilities for nearly all surgeons, C.A.CHIR.MEX. Cours Avancé de Chirurgie en Mission Extérieure (Advanced course for deployment surgery). We must build the training around three axes: feedback to highlight the need for adaptability, theoretical focus on standardised recommendations and surgical practice. C.A.CHIR.MEX objectives are:

- To teach the surgeons the different surgical specialised skills useful on external missions and the principles of surgery adapted to the logistic and social context
- To teach the basic steps of emergency surgery in this context
- To teach the principles of surgical treatments within the framework of the medical assistance to the civil populations

Conclusion

Amputation, although never being the primary goal of the physician, may well be the procedure of choice in some

cases. The decision to perform an amputation is always a difficult one. To understand the context of the particular exercise in an atmosphere of disaster is critical to the strategic choices of conservation or, conversely, no conservation. To be prepared for this eventuality is a moral obligation and a practical necessity. There is no dogma; however, there is a duty to respect the principles of indications and techniques in amputation situations. We have a duty of excellence for those patients who have no free choice.

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