Extravasation: Surgical Management and Prevention

Asmaa Chfiri, Sara Karti, Amal Jalal, Ahmed Jaafar, Mehdi Alaoui, Sarah Sabur, Amine Harti, and Mounia Diouri

ABSTRACT

Extravasation is defined as the leakage of fluid from a blood vessel into the surrounding area at the injection site. These accidents occur during injection for diagnostic or therapeutic purposes, carried out through the peripheral or central venous lines (Chemotherapy, metabolites, or contrast agent for radiographic examination). They can be the cause of skin necrosis able to progress to significant functional, cosmetic, and psychological sequelae.

The saline washout technique is the emergency surgical treatment of choice for extravasations of certain products, allowing the elimination of the toxicant and the preservation of the skin. In the event of skin necrosis, covering techniques such as directed healing, grafts and flaps allow healing.

The difficulty of the therapeutic management of these lesions and their unpredictable evolution, require prevention, by the development of protocols for the installation and monitoring of the venous catheters, and by the continuous training of the nursing staff to know the symptoms of extravasation, and their immediate management.

The aim of this work is to present a review of the existing literature, allowing to know the diagnostic criteria, insist on the means of prevention, and propose a protocol of management.

Keywords: Coverage, debridement, extravasation, infiltration, infusion, surgery.

I. INTRODUCTION

Extravasation injury is defined as the damage caused by the efflux of solutions from a vessel into surrounding tissue spaces during intravenous infusion. It is a complication that can occur during injection for diagnostic or therapeutic purposes, via the peripheral or central venous lines. Several products may be involved: anticancer drugs, contrast agents for radiological examinations, or infusion of nutrition or resuscitation metabolites [1]-[3].

It is an iatrogenic incident that can cause skin necrosis that can extend to involve nerves, tendons, and joints leading to significant functional and aesthetic sequelae [2], [4].

Diagnostic and therapeutic management is an emergency and involves, first, informing all medical and paramedical staff of the various diagnostic aspects, the emergency procedures to be carried out, the possibilities offered by plastic surgery to overcome these incidents, and the rules to be followed to prevent them [1], [2], [4], [5].

If treatment is delayed, surgical debridement, skin grafting, and even amputation may be the unfortunate consequences of such an injury [5].

It can be the cause of a postponement of chemotherapy, a prolonged hospitalization, or even a devastating surgery [6].

The aim of this work is to present a review of the existing literature, allowing to know the diagnostic criteria, insist on the means of prevention, and propose a protocol of management.

II. METHODOLOGY OF THE LITERATURE REVIEW

Our study consists of a review of the existing literature with the presentation of some cases admitted to the Department of Plastic and Reconstructive Surgery in Casablanca, Morocco.

The scientific literature search was conducted to review the current evidence of effective therapies that may provide benefit in reducing the severity of extravasation injury in our patients. The PubMed database and the ScienceDirect publisher platform were used. All types of studies evaluating one or more treatments were included in the search, without date limitation. Bibliographies of key articles, guidelines and case reports were also evaluated for other treatment-related
references. The research was also conducted on antidotes and offending agents discovered by the broad search.

Several keywords were used, as well as their synonyms found on sites offering specific indexing vocabularies to certain databases such as the Grand Dictionnaire Terminologique and MeSH (medical subject heading). Here is the complete list:

- In English: Extravasation, Infiltration, Infusion, Metabolites, parenteral nutrition, Chemotherapy, Antineoplastic agent, Vesicant, Irritant, Cytotoxicity, Implantable port, Chemo port, Antidote, Surgery, Saline flush out, Skin necrosis, Debridement, Coverage, Directed healing, Skin graft, Flap.


III. DISCUSSION

A. Definitions

Extravasation corresponds to the extravascular passage of a perfusion product and its tissue diffusion at the injection site [1]. Some articles differentiate between extravasation and infiltration. Extravasation is generally limited to materials that are known vesicants. Conversely, infiltration involves any non-vesicant solution. Infiltrations may or may not cause some degree of local tissue inflammation or patient discomfort. These definitions have been used to differentiate the need for urgent intervention, and thus should be considered with caution, as untreated infiltrations can still cause severe pain, compartment syndrome, or even necrosis if not treated early [7]-[11].

B. Risk Factors

Some risk factors (RF) may increase the likelihood of extravasation. These may be related to the drug, the patient, or the administration technique [1], [2], [12]-[14].

- Patient-related factors
Some RF may be related to difficulties in communication with a patient, alteration of the venous wall, and reduced venous and lymphatic circulation (Table I).

- Factors related to the administration technique
Other RF may be related to inappropriate injection site or technique, and failure to address patient-reported symptoms (Table II).

- Drug-related factors
Damage associated with extravasation can be explained by phenomena of ischemic nature and direct cellular toxicity (Table III).

C. Etiologies

It occurs most often during the administration of chemotherapy, or infusion of metabolic solutions [1], [4].

1) Metabolic solutions

Any product injected intravenously is likely to diffuse and cause tissue necrosis. Mechanisms involved include extreme pH, hyperosmolality, concentration, duration of exposure, and high quantity (Table IV) (Fig. 1, Fig. 2).

Unlike anticancer drugs, they have no cytostatic effect (no direct cellular toxicity) [1], [3], [8], [12], [14], [15].

Fig. 1. Extravasation of hypertonic glucose solution causing skin necrosis of the forearm.

Fig. 2. Extravasation of contrast product, patient seen at d4, excision of infiltrated tissue and skin graft after verifying the absence of damage to the noble elements of the hand.

2) Antineoplastic drugs

These drugs have direct cellular toxicity (cytostatics). They can be grouped into the following three categories based on their ability to cause tissue damage upon extravasation: vesicant agents, irritant agents, and non-irritant agents (Table V) [1], [2], [4].

a) Vesicants agents

Vesicant agents can cause progressive tissue destruction when injected out of the vein by the vesication effect. These lesions can range from simple redness to the formation of blisters, necrosis, ulcers, or even damage to tendons, ligaments, nerves, or bone.

The extravasation of a vesicant agent causes a real chemical burn, dose-, concentration- and site-dependent; and therefore, must be considered a medical emergency. Urgent diagnostic and therapeutic management are necessary to prevent necrosis and functional loss of the affected limb. Vesicant agents can be divided into two subcategories, depending on the mechanisms that cause tissue damage:

- DNA binding agents
These drugs are absorbed locally and they enter cells; they bind to DNA nucleic acids and cause cell death by apoptosis. After cell lysis, the vesicant agent is released at the site and phagocytosed by a neighboring cell, which perpetuates and increases tissue necrosis. The necrosis may be progressive over time (up to six months after extravasation), and thus the lesions become larger, deeper, and more painful.

- Non-DNA-binding agents
These agents induce cell lysis without direct DNA binding.
Being metabolized in the tissues, they are more easily neutralized than DNA-binding agents and the damage remains localized. The result is an injury that is similar to a burn, which may result in ulceration, is mild to moderately painful, but improves over time. And so, tissue healing occurs within 3 to 5 weeks.

### TABLE I: PATIENT-RELATED RF

<table>
<thead>
<tr>
<th>Communication difficulty</th>
<th>Alteration of the venous wall</th>
<th>Decreased lymphatic flow and venous return</th>
<th>Other RF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme ages: Children, geriatric patients.</td>
<td>Sedated patient, confusion, mental disorder.</td>
<td>Stasis or increased venous pressure (right heart failure).</td>
<td>Decreased pain perception with organic or iatrogenic origin:</td>
</tr>
<tr>
<td>Fragile/mobile veins or narrow diameter, sclerotic vein.</td>
<td>Multiple injection (drug addiction, dialysis, transfusion...), risk of venous spasm.</td>
<td>After lymphadenectomy or radiotherapy (cancer)</td>
<td>- Peripheral neuropathy (diabetes)</td>
</tr>
<tr>
<td>Generalized disease (obesity)</td>
<td>Superior vena cava syndrome</td>
<td>Superior vena cava syndrome</td>
<td>- Unconscious or agitated patient.</td>
</tr>
</tbody>
</table>

### TABLE II: RF RELATED TO ADMINISTRATION TECHNIQUE

- Inappropriate injection site (dorsum of the hand);
- Non-optimal injection technique (velocity of administration, lack of venous return, peripheral venous route more likely to cause an extravasation than a central route, with two locations that can cause handicapping sequelae: the anterior side of the elbow and the dorsum of the hand: areas where the subcutaneous tissue is very thin, thus generating skin fragility);
- Multiple injections (condition of the injection site);
- Insufficient immobilization of the infused limb;
- Waterproof dressings preventing the puncture site from being seen, and thus its visual monitoring (diffusion, redness, swelling);
- Failure to take into account reported symptoms that could be signs of extravasation;
- Lack of patient information.

### TABLE III: DRUG-RELATED RF

- The cytotoxicity of chemotherapy products (direct cellular toxicity)
- Concentration of the active ingredient and/or excipients;
- The hypertonicity of solutes (Ca, K, glucose, parenteral nutrition);
- pH
- Extravasated volume (mechanical compressions by the solute to the vascular and nervous vessels)
- Vasoactive substances
- Duration of exposure
- Infection

1) Irritants

Irritants create local inflammatory reactions without necrotic progression. The irritation is the consequence of a vascular spasm due to the local toxicity or insolubility of the product. This spasm increases the risk of diffusion by constituting an obstacle to free venous flow. Irritants may produce a transient effect characterized by a burning sensation and pain and/or inflammatory signs.

Some organizations group these drugs into a class called "irritating agents with vesicant properties". This class includes agents capable of causing tissue damage and ulceration, and whose potential for damage is proportional to the amount and concentration of drug extravasated.

2) Non-vesicants and non-irritant

These agents usually produce no local reaction at the injection site or to surrounding tissues upon extravasation. Occasionally, patients may notice mild inflammation and discomfort [1], [4], [13], [16].

### D. Clinical Diagnosis

In principle, the first hours are characterized by benign symptomatology that does not presume anything about future evolution. The stigmata of local inflammation may appear early on: pain, described as a burn, followed by redness and induration at the injection site, heat or sometimes luid teguments accompanied by blisters; visible accumulation of fluid under the skin, or in severe cases, necrosis or ulceration. Rarely, the clinical symptomatology may include only discrete local signs (Fig. 2, Fig. 3).

These symptoms can be observed at the time, or after the injection (minutes, hours, and up to a few months later). Whether administered by peripheral or central venous line.

Alternatively, extravasation can occur without any of these signs or symptoms occurring. The diagnosis is then confirmed by the absence of blood reflux in the venous line, difficulty in injection, and reduction in infusion rate [1], [2], [4], [6], [12].

The Millam classification (Table VI) is one of the most widely used tools to assess the severity of a skin lesion following extravasation [5], [8], [17].

1) Injury topography

Affecting the volar aspect of the hand, the wrist, and the elbow crease can have serious consequences. Necrosis can expose the underlying structures: vessels, nerves, tendons, and bones. The forearm is therefore a less dangerous region.

In the case of central administration, symptoms may manifest in the chest, shoulders, neck, or along the entire catheter line. No symptoms can confirm the diagnosis of extravasation, but the venous return should be checked and a differential diagnosis made [4].

### TABLE IV: THE MAIN NON-ANTEOPLASTIC AGENTS RESPONSIBLE FOR NECROSIS

- Parenteral nutrition solution
- Lipids
- Hypertonic glucose solution
- Calcium salt
- Potassium chloride
- Sodium bicarbonate
- Vasoactive substance (norepinephrine, dopamine)
- Contrast agent
- Antibiotic (chloramphenicol, cephalotin, gentamicin, oxacillin...)

Fig. 3. Livid integuments with blisters on the back of the hand.
E. Differential Diagnosis

The distinction between the signs of extravasation and the other reactions is essential to making the correct diagnosis because it changes the treatment.

1) Venous irritation phenomenon

It manifests as pain at the injection site with signs of local phlebitis. On examination: absence of edema and presence of venous return. With a favorable evolution, it compromises vascular access to the limb but does not contraindicate the use of the substance. Its only treatment is prevention through the use of a diluted infusion in a large, fast-flowing vein.

2) Hypersensitivity reaction

It is a local reaction with painful pruritus, erythema, and urticaria all along the line of the punctured vein. A real tracer phenomenon is observed. Antihistamines are ineffective and the infusion must be stopped [1], [4].

![Fig.4: Saline flush out technique performed in the operating room for cytotoxic extravasation of the back of the hand.](image)

F. Evolution:

1) Non-antineoplastic agents

An eschar can appear in 1 to 2 weeks, its evolution towards healing by wound healing being the rule, unlike cytostatic agents.

2) Antineoplastic agents

   a) Favorable evolution

   Tissue damage can be moderate with the appearance of an indurated erythematous plaque that may persist for up to 12 months.

   Persistent pain after 24 hours and the early appearance of induration, indicate severe damage and announce tissue necrosis, developing superficially and deeply to leave, in 4 to 13 weeks, an ulcer exposing the underlying tissue. The bottom is covered with fibrin, the edges are raised and there is a painful inflammatory crown on the periphery over 1 to 2 cm. Indolence and absence of granulation are characteristic. There is no tendency for spontaneous healing.

   c) Local complications

   The severity of the injuries depends on the type and concentration of the extravasated product and the site of infusion. The damage to the noble elements of the region is secondary, on the one hand, to the toxic effect of the product, and on the other hand, to their exposure after skin necrosis (vascular, nerve, tendon, periosteal damage). Later, progressive joint stiffness due to toxic synovitis, sometimes compressive neuropathy, lymphoedema, and algodystrophic syndromes appear.

   The repetition of infusions, the vascular state of the upper limb, and the general terrain also contribute to this (Fig. 4, Fig. 5).

   d) General complications

   The ulcer represents an obvious gateway in fragile patients, immunocompromised by chemotherapy, and local infections are common, which can generalize to sepsis [1], [2], [4].

| TABLE V: CLASSIFICATION OF ANTICANCER DRUGS ACCORDING TO THEIR POTENTIAL FOR TISSUE NECROSIS |
| DNA-binding: | Non-DNA-binding: |
| Vesicants | Irritants: | Non-vesicants |
| -Alkylation agents: | -Vinca alkaloids: | Arsenic trioxide, |
| Busulfan, Carmustine, Cisplatin≥0.4mg/ml*, Methotrexate, Trabectedin | Vinblastine, Vincristine, Vindeistine, Vinorelbine. | Bendamustine, Cabazitaxel, Carboplatin, Carmustine, Cisplatin≥0.4mg/ml*, Cyclophosphamide, Daucarbazaine, Liposomal Daunorubicin, Doxorubicin, Eribulin, Topotecan, Etoposide, Etoposide phosphate, Undiluted Fluorouracil, Fludarabine, Fluorouracil diluted, Gemcitabine, Ifosfamide, Interferons, Interleukin-2, Methotrexate, Mitoxantrone, Pemetrexed, Ralitrexed, Thiopeta. |
| -Others: Actinomycin, Dactinomycin, Mitomycin, Mitoxantrone, Daucarbazaine, Fornustine, Streptozotocin | -Taxane: | Docetaxel, Paclitaxel*. |

*Usually classified as an irritant, but reported to be mild vesicants.
The directed wound healing as a preparation for surgical wound closure. After 24 hours, the treatment is no longer curative but aims to limit the damage.

Management protocols vary from one institution to another and according to local resources [1]-[3].

1) Emergency medical treatment
   e) General measures

As soon as the accident is recognized, non-specific emergency maneuvers are required. The aim is to limit the number of extravasated drugs.

- Stop the injection or infusion;
- Disconnect the infusion without removing the catheter;
- Aspiration of the persistent product (from the catheter or by direct puncture) to remove as much fluid as possible from the subcutaneous tissue;
- Avoid manual pressure on the site;
- Catheter removal;
- Delineate the outline of the extravasated area with a pen;
- Photograph the lesion;
- Immobilization and elevation of the limb (reduce edema);
- Analgesics and antibiotic prophylaxis (to prevent superinfection) and tetanus vaccination are the rules;
- Early rehabilitation if periaricular injection (limits functional impairment);
- Anti-inflammatory drugs are useless (no inflammatory reaction).

- Some teams suggest that compresses soaked in 30% glucose should also be applied to the extravasated area and that they should be repeated frequently during the first hour.

f) Injury assessment and severity criteria:
Collect information for initial documentation after performing emergency measures.

It is necessary to note: the time of occurrence, the type of product involved, the quantity injected, the treatments undertaken, and the clinical analysis of the injury (color of the skin, importance of the edema), and the contours of the area affected by the extravasation are marked with a demarcation pen. An X-ray image is taken when the contrast product is extravasated. In high-pressure injections, the elevation of creatine phosphokinases (CPK) in blood affirms compression and muscle suffering.

A document is developed for initial documentation and even follow-up.

To assess the risk of downstream ischemia and necrosis, elements of severity are sought on clinical examination: Cytotoxic product; High extravasated volume (greater than 10mL); High-risk anatomical site (dorsum of hand); Increasing or disproportionate pain; signs of skin distress (cyanosis, blisters, livedo); signs evoking compartment syndrome (edematous, tense, immobile limb, clawed posture, distal recocat time greater than 3 seconds).

In the presence of one or more signs of severity, a surgical evaluation must be requested urgently.

After performing the non-specific measurements and the injury assessment, further management depends on the drug involved and the degree of damage.

Two situations may be observed:

Early diagnosis, absent or moderate local toxicity, and low volume: conservative treatment is decided under cover of regular monitoring; in the absence of pain and necrosis on the 10th day, no additional treatment is necessary;

Late diagnosis, vesicant product, or large volume: surgical treatment must be undertaken urgently. It allows the removal of the toxicity and the neutralization of its effects and the recycling phenomenon in chemotherapy [1], [2], [4].

2) Conservative treatment
It can only be considered if the following conditions are met: product is known, non-cytotoxic, low volume of diffusion (less than 10 ml), low-risk anatomical site, accident recognized quickly, painless patient [1].

- Non-pharmacological treatment: application of heat and cold:

Heat is used when the extravasation involves a non-DNA binding vesicant agent, thus one can increase their elimination by creating vasodilatation by applying heat. Heat can be applied even in the case of radiopharmaceutical extravasation.

A cold pack is used when the extravasation involves a DNA-binding vesicant, an irritant (except for oxaliplatin: cold would increase diffusion), or a non-irritant. By vasoconstrictive effect, would seem to decrease diffusion and persistent chemical activity. Ice or a frozen dressing is applied to the extravasation area.

The administration of cold for anthracyclines and heat for vinca alkaloids intermittently over 24 to 48 hours, depending

<table>
<thead>
<tr>
<th>TABLE VI: MILLAM'S CLASSIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
</tr>
<tr>
<td>Class II</td>
</tr>
<tr>
<td>Class III</td>
</tr>
<tr>
<td>Class IV</td>
</tr>
</tbody>
</table>

Fig.5: Extravasation of anthracyclines on chemo port. Chamber extraction, saline flush out. The evolution was marked by the aggravation of the injuries and the appearance of necrosis required several times of excision. The directed wound healing as a preparation for Patient followed by wound healing, then skin graft. a, b: extraction of the chamber - c: extravasated product - d: skin necrosis - e: surgical debridement - f: defect before the graft - g: skin graft - h: appearance at one month.
on tolerance, is, therefore, the most appropriate regimen. Some articles suggest 45 minutes of cold for anthracyclines and hot for vinca alkaloids every 8 hours over 24 to 48 hours. In case of oxaliplatin: do not apply anything [1], [2], [4], [12], [17].

- Pharmacological treatments: Research and administration of an antidote:

Some antidotes are known to be effective, while others are only theoretically effective. Their use is infrequent. In some cases, however, if used appropriately, they can prevent the evolution of tissue necrosis. Their use may also aggravate necrosis (e.g., sodium bicarbonate) (Table VII).

Studies regarding the use of most antidotes are not all conclusive [1], [4], [8], [13], [15], [18]. Indeed, since the literature gives discordant results, we prefer to abstain rather than apply a treatment that may be deleterious.

3) Emergency surgical treatment (Fig. 4)

Blind early wide excision techniques have given way to conservative saline flush out techniques [19] derived from Gault [20] and Lambert [21]. This treatment is the technique of choice, and should be performed as soon as possible (6 hours, maximum within 24 hours) [12]. The indications are broad, limited by the constitution of tegumentary necrosis [1], [4].

It is a treatment that is both radical and conservative, suitable for lesions of any origin, before the appearance of cutaneous signs. The principle is the aspiration of the subcutaneous cellular tissue with a liposuction cannula after infiltration with saline, associated with abundant washing (500 to 3000 ml) [22].

The procedure is quick (30 to 45 min), simple and minimally traumatic, can be performed under local anesthesia (general anesthesia in children or cases of edema) [23], and the cost of scarring is minimal. However, if the time to surgery seems to be an important prognostic factor, the nature of the toxic agent also comes into play, through the importance of preoperative skin damage [4].

This technique is effective in the case of cytotoxics.

An X-ray before and after the procedure is recommended for the extravasation of contrast products [12].

Aponeurotomies are sometimes justified in the case of compartment syndromes following a high diffusion volume in an inextensible anatomical compartment [1].

4) Treatment of established skin necrosis (Fig. 2, Fig. 5, Fig. 6)

In the absence of diagnosis and early management, treatment is undertaken at the stage of constituted necrosis. An anesthetic assessment of the patient is essential. In patients who are often fragile, the treatment of the defect is aimed at limiting the number of repeat operations and minimizing the sequelae [4].

a) Surgical debridement

Debridement is performed in the operating room under strict aseptic conditions, most often under general anesthesia. It must be carcinological: very wide, removing necrotic and ulcerated tissues, the edges, and the erythematous zone as well as a flap of healthy skin. All repair failures seem to be related to insufficient excision of devitalized tissue. Limitations are difficult to appreciate, some authors have proposed fluorescence techniques to guide debridement, but their uncertain reliability and difficult of the application make their use controversial [1], [2], [4].

<table>
<thead>
<tr>
<th>Drug</th>
<th>Antidote</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthracyclines</td>
<td>Dexrazoxane (IV - H6 and H24: 1000 mg/m² - D2: 500 mg/m²) +/- DMSO (topical - every 8h for 7d)</td>
</tr>
<tr>
<td>Mechlorethamine</td>
<td>Sodium thiosulfate</td>
</tr>
<tr>
<td>Vinca alkaloids</td>
<td>Hyaluronidase (SC - 150 to 1500 U)</td>
</tr>
<tr>
<td>Vasopressors (Adrenalin, Noradrenalin, Dopamine ...)</td>
<td>Phenolamine (Injection - H12 - 5-10 mg/10 ml of SS9%)</td>
</tr>
</tbody>
</table>

5) Skin coverage

The skin coverage procedure varies depending on the size of the defect, the subcutaneous elements affected, and the structures exposed. It should be as simple as possible, following the classic Gillies scale. It is usually deferred until after debridement to ensure that there is no progression of necrosis or signs of infection [1].

h) Directed wound healing

Directed wound healing is only conceivable for small defects or when a new intervention is contraindicated. It can also be proposed as a waiting solution (preparation for a skin graft) [1], [2], [4].

i) Skin graft

A simple and rapid solution requiring a well-vascularized subsoil, allows the coverage of large surfaces. However, it is useless in case of bone, vascular, nerve, or tendon exposure [1].

j) Flaps

Locoregional, remote pedicled, or free flaps. They are more delicate to perform but provide vascularized tissue with better trophic than a skin graft and make it possible to cover the exposure of noble structure [1], [2], [4].

Figure 6: a: Extravasation of anthracycline on the dorsum of the hand, patient seen at day 2, b: excision of non-viable tissues, c: progressive necrosis of the dorsum of the hand, d: coverage by a abdominal flap and skin graft of the forearm, e: appearance at 2 months.

A special case of extravasation on chemotherapy ports:

The use of chemo ports is recommended to decrease the incidence of extravasations. Chemo port extravasation is less frequent but potentially more dangerous because of vulnerable surrounding anatomical structures (such as...
mediastinal or pleural involvement) and also because extravasation at this level can more easily go unnoticed.

There is currently no specific procedure for extravasations on chemo ports, but Kurul suggests using the same protocol as that used for peripheral extravasations [1], [4], [19], [24].

H. Prevention

In addition to the physical consequences, extravasation lengthens the hospital stay, the number of consultations, the duration of follow-up, and the cost of treatment. The medico-legal consequences are not negligible. Prevention is therefore fundamental. It requires qualified personnel and appropriate equipment.

1) Qualified staff

Raising the awareness of the nursing staff about the seriousness of extravasations and the organization of training courses recalling the good practices of infusion and monitoring would allow a reduction in the morbidity of the injuries.

Staff training concerns measures related to the injection site and the technique of injection (Table VIII).

<table>
<thead>
<tr>
<th>TABLE VIII: PREVENTIVE MEASURES RELATED TO PERSONNEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concerning the injection site:</td>
</tr>
<tr>
<td>- Knowing how to select a vessel with the correct</td>
</tr>
<tr>
<td>caliber and local condition;</td>
</tr>
<tr>
<td>- Use of the chemo port to improve patient comfort</td>
</tr>
<tr>
<td>and enhance safety;</td>
</tr>
<tr>
<td>- Avoid perfusing the hand, wrist and elbow, choosing the forearm on the non-dominant side;</td>
</tr>
<tr>
<td>- Do not perfuse an irradiated limb, a limb that has lymphadenectomy, or a limb upstream of a recent venipuncture.</td>
</tr>
</tbody>
</table>

Concerning the infusion technique: Look for venous reflux and inject 20 ml of 0.9% NaCl: no local swelling should appear, the injection should be painless (if in doubt, opacify the catheter); Cover the catheter with a transparent dressing allowing monitoring of the site; For prolonged treatments, in the event of poor venous condition or the use of potentially cytotoxic agents, a chemo port is preferred; When the patient is agitated or unable to understand the instructions, the caregiver holds the limb to help the nurse insert the catheter under good conditions; Successfully perform the puncture on the first try (warm dressings and local nitrates promote vasodilation). Monitor the patient during the infusion; And test the permeability of the catheter: Frequently check the infusion rate and the blood reflux in the tubing;

2) Appropriate equipment

Implement a soft plastic catheter that accepts patient movement; Use of chemo port to improve patient comfort and enhance safety. But this does not eliminate the risk of extravasation.

3) Establishment of adequate emergency treatment

This implies good information and awareness of the nursing staff.

Most authors recommend the implementation of management protocols detailing the specific measures to be taken, with the provision in each institution of an extravasation kit and a register for reporting infusion accidents [1], [2], [4]-[6], [12], [13], [17].

IV. CONCLUSION

Extravasation is a diagnostic and therapeutic emergency. Skin injuries can range from irritation to ulcers for antineoplastics, hence the importance of prevention.

Non-compliance with the injection protocol for an antineoplastic drug is, given the risks it presents, a dangerous attitude that may call into question the medico-legal liability of the infuser.

CONFLICT OF INTEREST

Authors declare that they do not have any conflict of interest.

REFERENCES


