The strategic role of the nurse in the selection of IV devices

Thais Queiroz Santolim, Luiz Augusto Ubirajara Santos, Arlete Mazzini Miranda Giovani and Vanessa Cristina Dias

Abstract

Use of vascular devices represents one of the most common procedures used as a complementary measure in the treatment of patients. An indication algorithm was established to serve as a guideline for nurses in choosing the best intravenous device, considering the main variables of drug therapy. A protocol approved by the Institute of Orthopedics and Traumatology of Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo (IOT-HCFMUSP), where the authors work, was subsequently established and the nurse carried out the evaluation for the indication of both the peripheral device and the central device, whether a peripherally inserted central catheter (PICC) or other device inserted by the physician. As a result, there was a decrease in the incidence of phlebitis from 0.77% in 2010 to 0.17% in 2011, with an annual curve of negative tendency. The nursing team also appeared more satisfied, diminishing stress related to puncture failure.

Key words: Intravenous devices ■ Indication of intravenous device ■ Intravenous therapy

Prolonged intravenous therapy requires adequate venous access and frequent use of the superficial venous network can lead to its depletion, causing damage such as sclerosis, phlebitis and leakage. Haemodialysis, chemotherapy, prolonged administration of antibiotics, bone marrow transplants and parenteral nutrition are all treatments that require long-term venous access. In addition to these indications, there are blood transfusions, successive blood collections for the performance of tests and intravenous therapies. Short peripheral catheters progressively give way to longer, preferentially central tunnelled or non-tunnelled catheters, and completely implanted catheters (Bonassa, 2000).

Health professionals must be familiar with the devices, but it is also essential that they can act with proficiency, skill and safety in the analysis of the patient's condition, in order to select the best intravenous device.

The authors consider it the nurse's responsibility to establish peripheral venous access, central venous access of peripheral insertion and to take part in the choice of the central access together with the physician in charge of the patient's care (Mendonça et al, 2011).

There are many catheters available on the market today and the technological advances of these devices makes them increasingly inert and biocompatible, yet a series of complications can still occur.

According to Brannen and Surette (1997), these complications may be related to physical and chemical factors. Among the physical factors, we should consider insertion techniques, the anatomy of the site, the size and type of device, number of insertions, catheter in situ for more than 72 hours, the severity of the disease and pre-existing infections. On the other hand, chemical factors include the infusion of irritant drugs (such as intravenous vancomycin) and the concentration of the infusion (hyper or hypotonic).

In this context, as nurses are responsible for the daily device maintenance procedures and for drug administration, they play a crucial role in the prevention and reduction of complications related to venous access. For this reason, it is essential they are familiar with intravenous devices, the condition of the patient's venous network and the characteristics of the drugs to be infused.

Table 1. pH of the antibiotics standardised by SCIH - IOT

Cefazolin (Kefazol®)	pH 4.5 to 7
Cefepime (Maxcef®)	pH 4 to 6
Cefuroxime (Zinacef®)	pH 5 to 8.5
Ceftriaxone (Rocefin®)	pH 6.6 to 7
Ceftazidime (Fortaz®)	pH 5 to 8
Clindamycin (Dalacin®)	pH 5.5 to 7
Gentamicin (Garamicina®)	pH 3 to 5.5
Oxacillin (Staficilin®)	pH 6 to 8.5
Imipenem (Tienam®)	pH 6.5 to 7.5
Ciprofloxacin (Cipro®)	pH 3.3 to 4.6
Teicoplanin (Targocid®)	pH 7.2 to 7.8
Vancomycin (Vancocid®)	pH 2.4 to 4.5
Metronidazole (Flagyl®)	pH 4.5 to 7
Amphotericin B (Amphocil®)	pH 5 to 8

Thais Queiroz Santolim is Nurse and Assistant Director of the Division of Nursing; Luiz Augusto Ubirajara Santos is Nurse and Dentist; Ariete Mazzini Miranda Giovani is Nurse and Director of the Division of Nursing and Vanessa Cristina Dias is Nurse and Coordinator; all at the Diagnostic Center of the Institute of Orthopedics and Traumatology, Hospital das Clínicas of the School of Medicine of the University of Sao Paulo. São Paulo/SP, Brazil.

Accepted for publication: October 2012

The authors of this article work at the Institute of Orthopedics and Traumatology of Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo (IOT-HCFMUSP), which handles complex orthopaedic trauma. It receives patients on a daily basis who will need intravenous therapy for a prolonged time. The main advantage is that upon their arrival at the service, patients' venous networks are preserved and should be until the end of the treatment.

After stabilising the patient, it is essential for the nurse to select the most suitable device to ensure safe and effective venous access at an early stage, since the drugs commonly used in the treatment of the Institute's patients have strong blood vessel damaging characteristics owing to the considerable variation of their pH levels (*Table 1*) and their high osmotic concentrations.

Depending on the pH and concentration of the drugs, they may produce damage at the insertion site or on the vascular route. The pH of a solution or medication determines its degree of acidity or alkalinity (Ferreira, 2002).

The normal blood pH is between 7.35 and 7.45. When the drug has an extreme pH level, i.e. is higher than 9 or lower than 5, these are classified as irritant drugs. This means that when administered in peripheral veins, they attack the endothelium, causing pain and a burning sensation, and producing chemical phlebitis with the appearance of palpable cord. The cephalosporins, e.g. oxacillin, gentamicin and clindamycin, are medications with this characteristic (Giovani, 2006). Tissue necrosis may also occur if there is any leakage of these medications (Giovani, 2006).

Table 1 presents the pH levels of the most commonly used antibiotics at IOT-HCFMUSP, according to the standardisation of antibiotics, proposed by the institution's Hospital Infection Control Subcommittee (HICS).

Osmolarity

Osmolarity is the concentration of a substance (osmotically active molecules) dissolved in 1 litre of solution. The osmolarity of blood is from 280–295 mOsm/litre. Solutions with an osmolarity very different from that of blood can cause pain and phlebitis when administered through short peripheral intravenous devices.

Based on osmolarity, solutions are defined as:

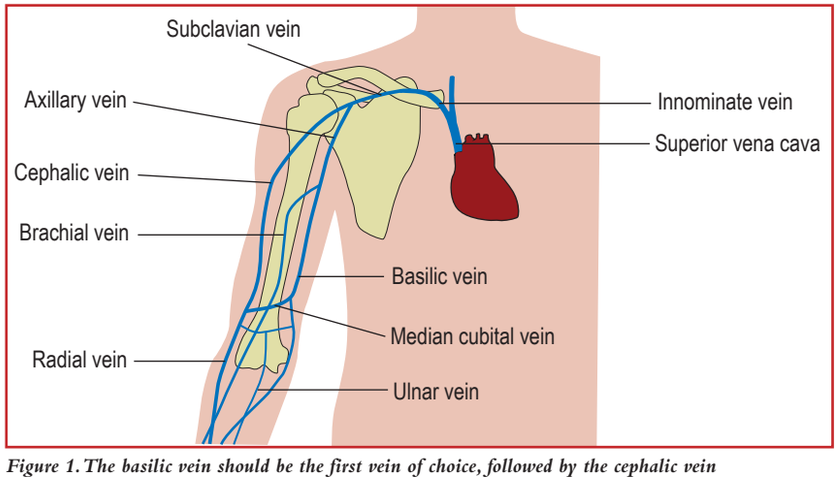

Figure 1. The basilic vein should be the first vein of choice, followed by the cephalic vein

- Isotonic solutions: when they do not cause changes in the cell volume. Their osmolarity is between 240 and 340 mOsm/litre
- Hypotonic solutions: makes the cell increase in volume with the possible occurrence of cell lysis (breaking down of a cell by an external force). Their osmolarity is below 240 mOsm/litre
- Hypertonic solutions: makes the cell lose water, decreasing its volume and reducing its size. Their osmolarity is above 340 mOsm/litre (Giovani, 2006).

The more acid and hypertonic the intravenous solution is, the greater the risk of chemical phlebitis. The risk of a patient developing chemical phlebitis based on the osmolarity values of the solutions and medications is as follows:

- Low risk ≤ 450 mOsm/litre
- Moderate risk = 450 - 600 mOsm/litre
- High risk ≥ 600 mOsm/litre.

Which vein to puncture and which device to select

The choice of which vein to puncture should be based on:

- Duration of the intravenous therapy
- Characteristics of the drugs
- State of the patient's peripheral venous network.

Prolonged intravenous therapies need reliable access. In these cases, the best selection is the central venous access, even when the patient has the entire peripheral venous network preserved. Options for central catheters include the peripherally inserted central catheter (PICC), tunnelled and totally implanted catheters. At the IOT-HCFMUSP, when the patient has a preserved venous network, the first option is the valved PICC, which allows intermittent use with a greatly reduced risk of obstruction, and that facilitates the patient's de-hospitalisation for treatment continuity. The vein (*Figure 1*) of first choice should be the basilic, as it is a vein of thick caliber, of medial location and with a smaller number of valves, favouring catheter progression. The second option should be the cephalic vein, where insertion is also facilitated owing to its caliber, keeping in mind that puncturing the vein above the antecubital fossa is preferred.

With regards to the characteristics of the drugs, we should always know their pH and osmolarity, since as mentioned, acid, alkaline, hypotonic and hypertonic drugs can cause irreversible histological alterations to the vessel endothelium, as well as complications in cases of leakage. Therefore, drugs with these characteristics should also be administered centrally.

Peripheral veins are only selected in short therapies and when the solution to be administered is not harmful to the blood vessels. Nevertheless, puncturing the vein near the joints should always be avoided because of the greater risk of mechanical phlebitis caused by the movement of the limb, and the catheter with the smallest caliber is preferred. The arm veins are the most appropriate because they produce a lower incidence of this complication and afford more freedom of movement to the patient, which is very important when considering the orthopaedic patient who frequently makes use of crutches and other aids to get around.

Based on this knowledge, the nurses from the intravenous

(IV) therapy group of the Institute of Orthopedics and Traumatology (IOT) use an intravenous device algorithm in order to help them in their daily practice for the choosing the best device for the infusion of solutions.

The algorithm facilitates the professional's reasoning when indicating the device, besides producing important considerations for the success of therapy continuity.

Intravenous therapy group

The IV therapy group at the Institution was created in 1999 after the first nurses completed the PICC insertion certification course. Since then this group, which is formed of nurses representing all medical care areas, has had the important role of guiding the team with regards to the best practice in IV therapy through the preparation of protocols and training programmes based on the evidence in literature.

The work of the group together with the medical team was essential for nurses to gain visibility and autonomy in the selection of the IV device (*Figure 2*). As the professional who handles and assists patients with venous access most often, the nurse is the most qualified to analyse and select the device. It is also the role of this group to keep track of the indicator of phlebitis, bloodstream infection and central catheter losses, as well as to develop any improvement actions (Alexander, 2011).

Results

After the publication of the protocols in 2010 and the training of the entire team of nurses in the selection of the most appropriate IV device with the lowest risk of complications, using the proposed algorithm, the authors observed a decrease in phlebitis incidence, as shown in *Figure 3* showing 2010, *Figure 4* showing 2011 and *Figure 5* showing January to June of 2012.

As the correct device is inserted early on at the beginning of the therapy, the patient is submitted to fewer painful procedures for the insertion of catheters.

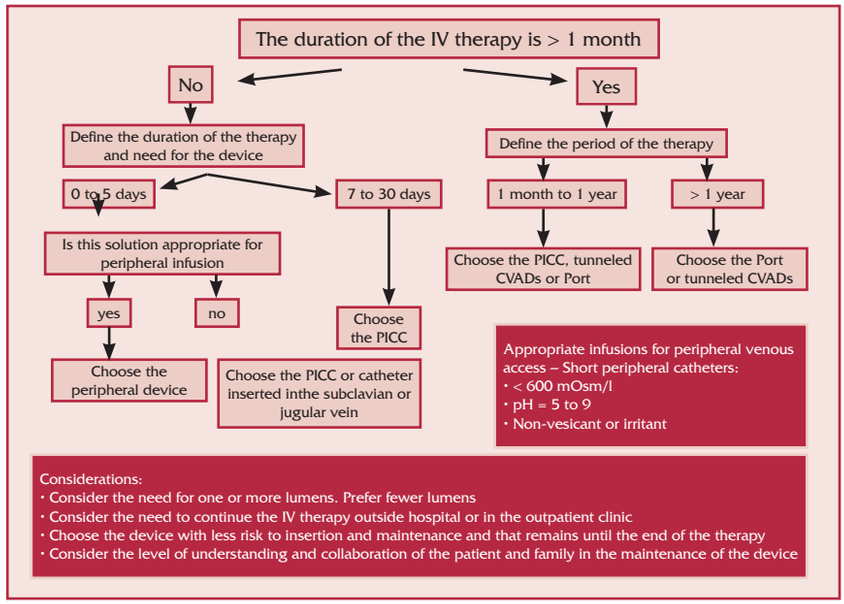

Figure 2. Selection of the IV device for performance of the venipuncture

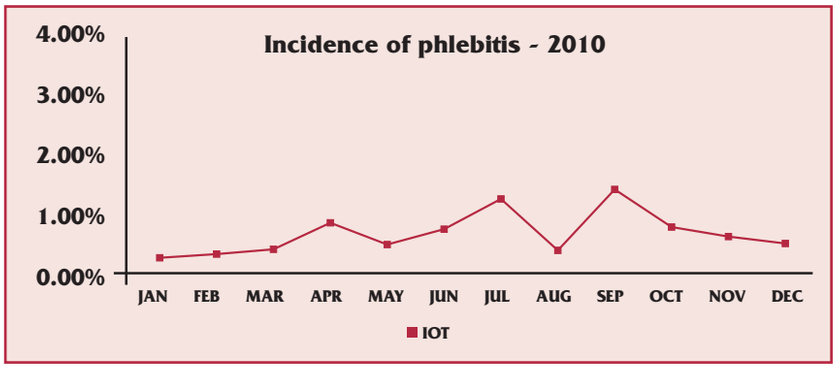

Figure 3. Incidence of phlebitis - 2010

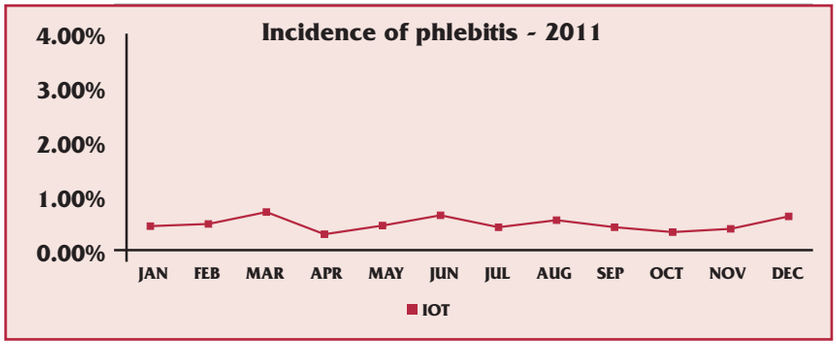

Figure 4. Incidence of phlebitis – 2011

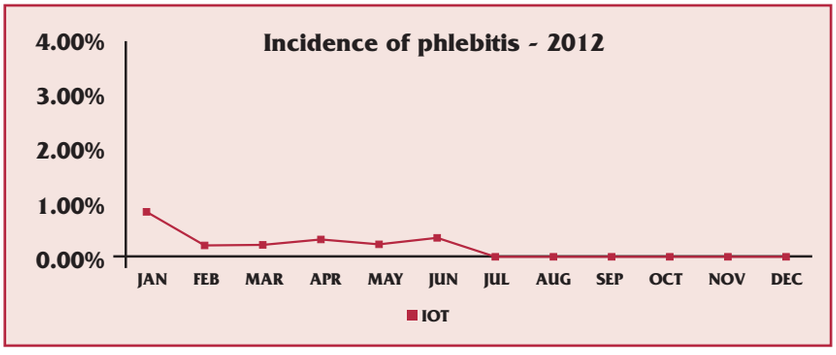

Figure 5. Incidence of Phlebitis – January to June 2012

The nursing team also manifests greater satisfaction and less stress since they feel confident they are administering the medications at the correct times and have safe and reliable access.

Discussion

Nurses with concrete knowledge, trained in intravenous therapy are crucial for quality nursing care.

In preparing the care plan, the nurse should monitor the evolution and the effectiveness of the prescribed therapy, documenting the patient's response and the interventions necessary to achieve the expected result (Alexander, 2011).

Studies show that the rate of local complications such as phlebitis was lower in patients who received care from nurses trained in intravenous therapy (Soifer et al, 1998; Karadag and Görgülü, 2000), making it clear that this professional is important in care provision and in the follow-up of protocols that aim to reduce the risks and the complications of intravenous therapy, acting directly in the choice of the insertion site and of the device.

In recent years incidence of phlebitis at the Institute has decreased from 0.77% in 2010 to 0.17% in 2011, with annual curve of negative tendency. However, the goal is always to be as close as possible to zero, since the institute has nurses trained in indicating and maintaining intravenous devices besides prescribing the correct dilution for each type of catheter.

Conclusion

The low incidence of phlebitis and other complications arising from intravenous therapy is only possible with the involvement and commitment of the entire nursing team. The confidence of the medical team in delegating the indication of the device to the nurse was an achievement resulting mainly from the work of the intravenous therapy group that plays the important role of bringing the latest, safest procedures into medical practice, ensuring drug therapy without complications and damage to the patient. BJN

Conflict of interest: none.

Alexander M (2011) The new gold standard in infusion nursing. *J Infus Nurs* **34**(1): 11

Bonassa EAM (2000) *Enfermagem em Terapêutica Oncológica*. 2nd edn. Atheneu, Rio de Janeiro

Brannen S, Surette D (1997) Monitoring i.v.-site infections. *Can Nurse* **93**(3): 49-50

Ferreira AO (2002) *Guia Prático da Farmácia Magistral*. 2nd edn. Pharmabooks, São Paulo.

Giovani AMM (2006) *Medicamentos: cálculo de dosagens – guia de consulta rápida*. 3rd edn. Editora Scrinium, São Paulo.

Karadag A, Görgülü S (2000) Devising an intravenous fluid therapy protocol and compliance of nurses with the protocol. *J Intraven Nurs* **23**(4): 232-8

Mendonça KM, Cunha Neves HC, Silva Barbosa DF, Silva e Souza AC, Veiga Tipple AF, Aparecida do Prado M (2011) Nursing care in the prevention and control of catheter-related bloodstream infections. *Rev. Enferm* **19**(2): 330-3. http://tinyurl.com/ckwenlj (accessed 14 November 2012)

Soifer NE, Borzak S, Edlin BR, Weinstein RA (1998) Prevention of peripheral venous catheter complications with an intravenous therapy team: a randomized controlled trial. *Arch Intern Med* **158**(5):473-7

KEY POINTS

- Prolonged intravenous therapies need reliable access
- Peripheral veins are only selected in short therapies and when the solution to be administered is not harmful to the blood vessels
- It is essential for the nurse to select the most suitable device to ensure safe and effective venous access at an early stage
- The choice of which vein to puncture should be based on duration of the intravenous therapy, characteristics of the drugs and state of the patient's peripheral venous network