



## FUNDAMENTAL ELEMENTS OF INFUSION THERAPY

The second section of these lecture notes will provide information about the fundamental elements of infusion therapy. Let us look at the standard definition of “infusion”:

### Definition

**Infusion (lat. *Infundere, infusus*):**

**The introduction of liquids into the body in a process that circumvents the gastro-intestinal tract. Usually the liquid is introduced into a vein (intravenous), less often an artery, the subcutaneous adipose tissue (earlier customary as a subcutaneous saline infusion)**

Infusion thus means the introduction of liquid into the body – venously, arterially or subcutaneously. The medical indication determines which substances must be administered to the body. Infusion therapy deals with the question: “How can I bring this substance/solution (optimally) into the body?”

To answer this question, knowledge of various factors is required which are dealt with in the section “Infusion Therapy” of these lecture notes.

To begin with, various infusion containers will be presented which have different advantages and disadvantages depending on their respective characteristics. The chapter dealing with infusion solutions then gives an overview of the treatment fields in which infusion therapy is used and in the process indicates the most important solutions for the different application fields. A chapter on infusion technology follows

which systematically presents the different application possibilities. In the final chapter, you receive information concerning the dosage of the infusion quantities and learn about the function of the various kinds of infusion equipment which have a considerable influence on the exactitude of the dosage.

## 6

**Training Objectives:**

- ✓ Gain an overview of the various infusion containers
- ✓ Ability to cite the most important advantages and disadvantages of the various infusion containers as well as their areas of application

# THE INFUSION CONTAINERS

In the following chapter, the advantages and disadvantages of different infusion containers are explained and the special features of the containers are identified. Infusion containers may be distinguished on the basis of characteristics such as their area of application, transparency, sturdiness, weight, sterility, user-friendliness, environmental impact, etc.

## 6.1 The Glass Bottle

In earlier times, glass bottles were the standard container; today they are increasingly being superseded by plastic containers or bags. On the basis of their advantages, however, glass bottles are still the container of choice for special solutions and applications.

The glass bottle features various **advantages**. It is:

- **transparent** - this criterion is particularly important for the detection of particles (there are also coloured bottles for light-sensitive contents).
- **gas-proof and chemically inert** - i.e. it does not react chemically with the contents and is thus suitable for all types of infusion solutions.
- always the same size and therefore it is **easy to calculate quantities**, because the graduation does not shift as the bottle empties.

The advantages of the glass bottle are, however, countered by various **disadvantages**. The glass bottle:

- **is breakable.**
- **has a considerable weight.**
- **must be vented** - this requires monitoring at the end of the infusion to prevent a possible air embolism.
- **cannot support a pressure infusion using a pressure cuff.**
- **has a piercing site which is not per se sterile** and must therefore be disinfected.
- **entails the risk of considerable particle contamination.**

**Note:**

**In the hospital, reuse of glass bottles is only possible when they contain the same solution and when a certain type of glass is used. Recycling can only be done via the usual public possibilities (glass disposal).**

## 6.2 Infusion bags

In Germany, infusion bags are not frequently used. In other countries, however, they are widely used and in some areas they are the predominant infusion container. To avoid perforations, a special bag piercing spike is necessary.

Low weight, low costs and a range of application advantages have made bags popular particularly with standard solutions. Infusion bags feature the following **advantages**:

- They are **user-friendly**, i.e. it is not possible for the infusion system and in particular the drop chamber to run empty because the bag collapses and at

the end of the infusion there is an automatic stop of the fluid column thus making it a closed system which in turn makes an air embolism impossible.

- **The infusion sets functions without venting.**
- **It is easy to mix the contents** when admixtures are made.
- They are **flexible** (important for pressure infusions).
- They are **transparent** (important for detecting possible precipitations).
- They are **easy to use for a pressure infusion.**

## 6.2.1 BAGS MADE OF PVC

Bags also have **considerable disadvantages**, if made from PVC for example:

- **High particle contamination.**
- **High content of plasticisers.**
- **A high gas permeability** - therefore not suitable for all solutions (danger of oxidation). As storage time and temperature increase there is substantial water evaporation.
- There are **environmental problems** regarding the disposal of PVC. Incineration, for example, produced hydrochloric acids.
- Extreme absorption of many drugs.

## 6.2.2 ECOBAG® C.E. AND ECOBAG® I.V. – BAGS FROM B|BRAUN

The Ecobag® consists of a composite film made of polyethylene (PE) and polypropylene (PP). It has got three significant advantages:

- It has a **low particle contamination**.
- The **disposal of the Ecobag bags is environmentally harmless**; waste volume is small and in contrast to PVC-bags no hydrochloric acid and dioxins are produced during incineration.
- The material does not adsorb drugs.

## 6.2.3 THE MIXING BAG (NUTRIMIX<sup>®</sup> FROM B|BRAUN)

The mixing bag is used for preparing mixed infusions during total parenteral nutrition (TPN). It has got the following advantages:

- **Adjustment to the patient is possible:** Nutrition solutions for a whole day's requirements (2 -3 l) can be prepared in this bag for the special needs of the patient.
- **Reduced work:** The construction of large infusion regimens (administration via numerous different containers) is not necessary.
- **No incompatibility:** The danger of an incompatibility during infusion does not exist.
- **Low particle contamination:** Particle contamination – in contrast to large infusion regimens – is kept to a minimum.
- **Transparency:** The bag body is fully transparent.
- **Low level of contaminants:** The entire bag is free from PVC and plasticisers.

### Note:

If lipid solutions are added, then the mixed solution cannot be administered via an 0.2 µm filter. A special 1.2 µm lipid filter must be used.

## Nutriflex®, Nutriflex® Lipid from B|BRAUN

These products are pre-filled (ready to use) mixing bags for parenteral nutrition (PVC-free).

### 6.3 Plastic Bottles: Polyethylene Bottles

Particularly in Germany, plastic bottles are very widely used because they represent a good combination of the advantages of the traditional glass bottle and the plastic bag. The application fields are similar to those of plastic bags:

#### 6.3.1 PLASCO

The Plasco® is no longer produced by B|BRAUN. Because this product is still sold by other companies, its advantages and disadvantages are presented here to assess its fields of application.

Plasco® has got the following **advantages**:

- **Low particle contamination** in contrast to glass bottles and PVC bags.
- **Lower water evaporation** in contrast to PVC bags.
- **Low weight**: Plasco® is only half the weight of a glass bottle.
- **Unbreakable**.
- **Environmentally harmless**: Plasco® does not contain any plasticisers and is recyclable. Even when incinerated the only by-products are CO<sub>2</sub> and H<sub>2</sub>O.

The Plasco® also has the following **disadvantages**:

- **Venting of the system is necessary for complete emptying** (the bottle collapses slowly).
- **Clouding**: Plastic bottles have a slight clouding effect as a result of the material.
- **Exact fluid balancing is not possible** without venting and with a collapsed bottle.
- Larger amount of **air in the container**.

## 6.3.2 ECOFLAC® PLUS from B|BRAUN

The Ecoflac® Plus has got the following advantages:

- **Unbreakable.**
- **No venting necessary.**
- **Good handling, stable.**
- **Polyethylene is suitable for nearly all solutions.**
- **Low particle contamination.**
- **Space for the admixture of additional drugs.**
- **Low waste quantities, low weight.**
- **Recyclable.**

A disadvantage is the low accuracy of the scale, making fluid balance difficult.

## 6.3.3 MINI-PLASCO

The B|BRAUN company has launched the Mini-Plasco® as an alternative to injection ampoules. In the sizes 5, 10 and 20 ml, they serve as a replacement for glass ampoules and have got the following advantages:

- **Free-standing.**
- **Even open containers that fall over do not run out**
- **Opening without filing**, that means without splinters and the danger of injury.
- **Simple, problem-free disposal** (see Plasco® bottle)

**Note:**

**Glass bottles, plastic bottles, Ecobag® as well as mixing bags (NUTRIMIX®) are all being used with normal infusion sets (sharp, pointed and long piercing spikes). For the use of other infusion bags and for blood transfusion bags only the special bag infusion sets should be used because of the danger of perforation (For information about infusion sets, see Chapter 9).**

## 6.4 Summary

**Glass bottles, infusion bags and plastic bottles are available as infusion containers.** Infusion containers differ in regard to characteristics such as transparency, robustness, weight, sterility, user-friendliness, environmental characteristics, etc. Because of their different advantages and disadvantages, the different infusion containers are suitable for different areas of application.

Glass bottles, plastic bottles, Ecobag®, mixing bags (NUTRIMIX®) and ready-to-use systems such as Nutriflex® and NuTRiflex® Lipid are used with normal infusion sets (sharp, pointed and long piercing spikes). For the use of other infusion bags and for blood transfusion bags only the special bag infusion sets should be used because of the danger of perforation.

## 6.5 Comprehension Questions

- In what ways are the various infusion containers different from each other?
- List some of the important advantages and disadvantages of glass bottles, infusion bags and plastic bottles.
- What is to be observed when adding lipid solutions using in mixing bags?
- Which kinds of infusion sets are to be used with the different infusion containers?
- Why does venting of infusion containers play an important role?
- What effect does the choice of the container have on the choice of the infusion set?