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Parenteral Devices: A Review

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ABSTRACT

Parenteral administration of pharmaceutical merchandise is one of the most popular techniques used to produce the quick onset of action and add a hundred % bioavailability. The parenteral word is derived from the Greek word Para and Enteron, meaning outside of the intestine, and it is used for those dosage forms which are administered by routes aside from the oral route. The injections may be administered by such routes as intravenous (IV), intramuscular (IM) and subcutaneous (SC), intradermal, intraarticular, intrathecal. The nature of the product will determine the particular route of administration that may be employed. The objective of this review article is to provide information regarding different types of parenteral devices used for the administration of parenteral products, that includes syringes, needles, catheters, cannula, IV sets, etc. These devices are mainly made up of glass, plastics, and rubber.



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INTRODUCTION

The parenteral word is derived from the Greek word Para and Enteron, meaning outside of the intestine, and it is used for those dosage forms which are administered by routes aside from the oral route. The overall parenteral route is utilized when quick medication activity is wanted, as in emergencies, when the patient is uncooperative, unconscious, or unable to accept or tolerate oral medications, or when by other routes the drug itself is ineffective. The term "Devices" defines instruments, apparatus, and contrivances, including their components, parts, and accessories, intended for use in the cure, diagnosis, mitigation, treatment, or prevention of disease in man or other animals; or to affect the structure or any function of the body of man or other animals. The term "Parenteral Devices" is used for the equipment needed for the administration of parenteral drugs. These devices include syringes and cannulas. These devices must be sterile, pyrogen-free, and free from particulate matter.

PARENTERAL ROUTES OF ADMINISTRATION:

Parenteral drug administration is directly given through the skin, in or towards systemic circulation. It is the most suitable route of choice for drugs that cannot be absorbed orally and/or that are unstable in the gastrointestinal tract (e.g. insulin, heparin). These routes of administration are additionally utilized for the treatment of unconscious patients or under circumstances that require rapid onset of action. Parenteral routes of administration display higher bioavailability than other routes and also are subjected neither to the first-pass metabolism nor to the sometimes extreme conditions of the gastrointestinal environment. It offers the greatest control over the real drug amount that accesses systemic circulation. Drug administration by these routes is irreversible and can cause fear, pain, tissue damage, and/or infections are the main drawbacks of the parenteral route. Parenteral administration can be performed through injection (small volumes), infusion (large volumes), or implant. The injections may be administered by such routes as intravenous (IV), intramuscular (IM) and subcutaneous (SC), intradermal, intraarticular, intrathecal. The nature of the product will determine the particular route of administration that may be employed.

TYPES OF PARENTERAL DEVICES

1. Syringes-

It is a small plastic tube with a needle toward one side. Syringes are used to introduce medications through the intravenous route, intramuscular, or intradermal. They are

additionally used to draw blood and other body liquids for testing. Syringes without needles are useful in giving medications orally or into the feeding tube. Syringes are labeled based on how much liquid they can hold. Syringe capacity is measured in milliliters for liquids and cubic centimeters for the volume of solids. Syringes are available in sizes from 1 ml to 60 ml capacity.

Syringe tips have been categorized into four basic groups,

- Luer Lock Tip – Once attached, the needle is locked to the syringe until unlocked. It can not pop off accidentally.
- Luer Slip tip – The needle is placed onto a slip tip syringe without having the necessity of twisting it.
- Eccentric Tips – It is the right syringe tip if you are getting to introduce drugs parallel to the patient's skin such as a vein near the skin surface.
- Catheter syringe tip – The tip is tapered to enable the tubing to slip onto the tip. It is primarily used for irrigation.

Types of syringes

- Plastic syringe – It is the normally utilized syringe since it is cheap and dispensable. It accompanies a full plastic plunger tip or a rubber plunger tip. The rubber plunger tip is best because it minimizes the leaking of fluid past the plunger.
- Glass syringe – This type of syringe is used with a syringe pump. Glass syringes are non-disposable, reusable, and more accurate when compared to other types of the syringe. The plunger is often made of ground glass, metal with a Teflon tip, glass with a Teflon syringe tip, and metal-only. Glass syringe is more expensive as compared to a plastic syringe.
- Stainless steel syringe – The stainless-steel syringe is the most durable one as compared other types of the syringe. It is mainly used for high-pressure dosing applications. Due to the durability of the material, it is the most expensive type of syringe. Also, as it is not transparent that's why Health professionals may find it difficult to load and remove air bubbles.

2. Needles

Needles have a hub at one end that is attached to the syringe. Needles come in various lengths and gauge sizes. The tip of the needle has a bevel/slope which allows them to easily pass through the tissues. When it comes to choosing a needle for a syringe, there are a few things to keep in mind. They are the following:

- Gauge – When choosing a needle gauge, first consider the type of drugs to be given to the patient as well as the part of the body the needle has to pass through. The needle's thickness depends on its gauge. It has a corresponding number that indicates the needle's diameter. The diameter is wide when the gauge is low and if the gauge is high, it means that the needle is narrow. 26 and 27 are the common needle gauges, which are used for standard injections – intradermal, subcutaneous, and intramuscular. The less pain it caused when finer the needle passes through the skin. Low gauge needles are used for areas of the body with thick skin and also when the drugs to be given to the patient are viscous.
- Length – Needles vary in length ranging from 3/8 inch to 3-1/2 inches. When it comes to choosing the length of the needle, consider the injection site. For the introduction of drugs in the deeper part of the body such as intramuscular injections, longer needles are used.

Table No.1: Needle Selection

Sr. No.	Injection Site	Length Range (inch.)	GaugeRange
1	Intradermal	¼ to 5/8	24 to 26
2	Subcutaneous	¼ to 5/8	24 to 25
3	Intramuscular	1 to 2	19 to 22
4	Intravenous <i>Metal needle</i>	1 to 2	15 to 25
	<i>Winged needle</i>	¾ to 1 ½	16 to 23
	<i>Plastic needle</i>	3 to 5	15 to 21
	<i>Intracatheter</i>	1 ½	15 to 21
5	Intra-articulate	1 to 3	19 to 22
6	Intraperitoneal	4 to 6	14
7	Intramyocardial	¾	18 to 21
8	Intrathoracic	5 to 6	13

9	Intraspinal		
	<i>Adult</i>	3 to 5	20 to 22
	<i>Pediatric</i>	1 to 1½	25
	<i>Neonatal</i>	½ to 1	27
10	Hypodermocysis		
	<i>Adult</i>	2	19
	<i>Pediatric</i>	1 to 1 ½	20 to 22

3. Cannula

A cannula is a tube that is inserted into the body to remove or administer fluids as well as collect samples. In other words, a cannula covers the needle's surface, increasing the needle's effective length and making it easier to operate. They are also known as intravenous cannulas or IV cannulas and come in a variety of sizes and features. IV cannulas allow for a range of treatments and preventive caring options. The medical staff uses the cannula to administer drugs, fluids, or blood directly into the vein after it has been inserted. The cannula eliminates the necessity of using and injecting a new needle for each session or delivery. Peripheral IV Cannula and central line IV cannula are the main types of IV cannulas.

- **Peripheral IV cannula:** The peripheral IV cannula is the most widely used and is typically used by emergency room and surgical patients, as well as those undergoing radiological imaging. Each of these IV lines is merely used for a maximum of four days. It's taped to the skin with adhesive tape or a non-allergic alternative after being attached to an IV catheter.
- **Central line IV cannula:** This IV cannula is used for patients who are undertaking long-term treatments that require medication or fluids to be given over several weeks or months. They aid in the distribution of drugs more quickly, resulting in quicker responses. They're also useful for moving vast quantities of blood or other fluid through the patient's body. This IV cannula is inserted into the jugular vein, subclavian vein, or femoral vein within the neck.

IV cannulas of various sizes are color-coded to indicate their size and intended use. The scale of an IV cannula ranges from 14 to 24 gauge. The size is determined by the patient's condition, the IV cannula's function, and the urgency with which the fluid must be administered. For successful and proper patient care, it is important to understand the various types of cannulas and how they are used. These can only be used after a careful evaluation and approval from a physician.

4. Catheters

In the case of physiological and anatomical abnormalities or obstruction of the lower urinary tract, catheters are used to provide adequate bladder drainage, either temporarily or permanently. Catheters are used for several purposes, including maintaining bladder drainage during and after surgery or epidural anesthesia to reduce or eliminate the risk of distension injuries; investigations, for accurate urine output measurement, and measurement of post-micturition residuals; treatments, to relieve urinary retention or for chemotherapy installation; intractable incontinence, as the final option for containment.

The main types of catheters are indwelling catheters, external catheters, and short-term catheters.

- Indwelling catheters (urethral catheters) - It is a catheter that resides in the bladder. It may be known as a Foley catheter. It is also commonly known as balloon catheters because at its end it has a balloon. The balloon provides safety to the tip of the catheter in the patient's bladder. This type can be useful for long and short periods. These catheters are made from polyvinyl chloride, Teflon, polyethylene and should be radiopaque to ensure that they will be visible on x-rays films.
- External catheters (condom catheters) - A condom catheter is a catheter that is inserted into the body from the outside. The penis head is covered by a condom-like device. The condom unit is connected to a drainage bag by a tube.
- Short-term catheters (intermittent catheters) - For a short period after surgery, the person may need a catheter until the bladder empties. After the bladder emptying, it is necessary to remove the short-term catheter. This is referred to as an in-and-out catheter by healthcare professionals.

5. Feeding tube

A feeding tube is a medical device that is used to give nutrition to people who are unable to eat by mouth, cannot swallow safely, or need nutritional supplementation. The state of being fed by a feeding tube is called enteral feeding, gavage, or tube feeding. For the treatment of acute illnesses, placement may be temporary, or it may be permanent in the case of chronic disabilities. In medical practice, several feeding tubes are used. Polyurethane or silicone are commonly used. A feeding tube's diameter is measured in French units. French units (each French unit equals $\frac{1}{3}$ mm) are used to measure the diameter of the feeding tube. They are

classified based on the site of insertion and intended use. The procedures for inserting the tube are straightforward and relatively painless. The most common types of tubes include:

- A nasogastric tube (NG tube) is a tube that passes from the nose to the stomach.
- A nasojejunal tube (NJ tube) is a tube that passes from the nose, down the throat, through the stomach, and to the small intestine.
- A gastrostomy tube (G tube) passes through a small cut in the skin directly into the stomach.
- A gastroenteric or transgastric jejunal tube (GJ tube) passes through a cut in the skin directly into the stomach and extends into the small intestine.
- A jejunostomy tube (J tube) passes through a cut in the skin directly into the small intestine.

6. Stents

Stents are small and expandable tubes that are used to treat narrowed arteries. They can open narrowed arteries, reduce symptoms like chest pain, and help treat a heart attack in people with coronary heart disease caused by plaque build-up. A coronary stent is a medical term for these devices. They're usually made of metal mesh and are inserted into arteries after a procedure called angioplasty to widen the artery. Angioplasty is a procedure that requires no significant incisions and takes about an hour. It is performed under local anesthesia with mild sedation. It can take longer if the patient needs more than one stent. People who get stents have less pain and a shorter recovery time than those who have coronary artery bypass surgery, which is much more invasive.

7. Injection port

An elastomeric sleeve serves as a one-way valve on the injection port. When a syringe is used to administer medication, the elastomeric sleeve deflects, allowing the drug to pass into the catheter. After the injection, it returns to its original position, preventing any leakage or air entry.

8. Blood Transfusion set (B.T. Set)

It is made of plastic, is sterile, and has a non-pyrogenic pathway. It is non-toxic and intended for one-time use only. Spike with cover, Drip chamber, Filter, Roller clamp, Tubing, Cannula, Injection spot, Needle holder, Needle, Needle protector is included in the B.T.Set.

9. IV SET

IV SET is a device that is used to administer large amounts of parenteral. Consists of various components which are made up of various types of materials as mentioned below,

1. Spike cover - It protects the spike from the external environment and maintains its sterility.
2. Spike-It aids in piercing the closure or cap of the bottle. Its tip is sharp.
3. Drip chamber - It serves as a solution reservoir of a smaller size. It is squeezable and translucent. This effectively helps to keep air bubbles out of the fluid path.
4. Filter - It is placed at the bottom of the drip chamber and made up of nylon having a pore size of 15 μ .
5. PVC Tubing - The tube is colorless, soft, and transparent, having a length of 150 cm. It acts as a pathway.
6. Flow regulator - It has a two-part body and wheel. As a result, the flow rate is regulated.
7. Injection site - Small volume parenterals can be given to patients via this site when he is on IV fluid therapy.
8. Adapter - It is the distal end connection site for the needle.
9. Needle- It is covered with a cap that is made up of polypropylene.

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