

PARENTERAL FLUID REPLACEMENT THERAPY

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Purpose

- ▶ to discuss factors influencing the administration of i.v. therapy
 - ▶ selection of proper venous access (device)
 - ▶ proper intravenous route of i.v. therapy
 - ▶ advantages / disadvantages of different routes / venipuncture sites (peripheral/central)
 - ▶ risk of complications of i.v. therapy, etc.
- ▶ to identify common types of vascular access devices and describe their care and maintenance



Parenteral fluid replacement therapy

- ▶ fluids infused directly into circulating blood volume to supplement / replace body fluids
 - ▶ intravenous fluid and electrolyte therapy
 - ▶ blood therapy
 - ▶ partial parenteral nutrition (PPN) – combined with oral / enteral nutrition (nutritional support < 14 days), applied as *peripheral parenteral nutrition*
 - ▶ total parenteral nutrition (TPN) – i.v. hyperalimentation – all nutrients delivered by parenteral routes (nutritional support ≥ 14 days), applied as *central parenteral nutrition*



Responsibilities – NURSE

- ▶ preparation of medications to be administered i.v.
- ▶ assistance to the physician within the application (legal norms of the country)
- ▶ insertion of peripheral venous catheters
- ▶ assistance to the physician performing minor surgical procedures (insertion of central venous or arterial lines)
- ▶ maintenance of all the lines
- ▶ prevention of complications – intravascular therapy
- ▶ monitoring patient's responses



Responsibilities – PHYSICIAN

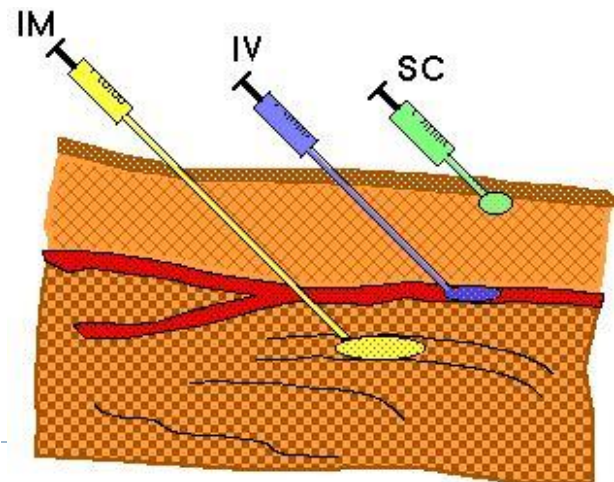
- ▶ order of the medications / infusion solutions to be administered i.v.
- ▶ insertion and removal of central lines – central venous catheter (CVC), PICC, implantable venous port, arterial lines
- ▶ application of all medications / infusion solutions intravenously (in the conditions of the SR)



Indications

– i.v. administration of medications:

- ▶ rapid effect of medication (onset)
- ▶ if other parenteral route:
 - ▶ too risky for the patient
 - ▶ medication too irritating to tissues
 - ▶ discomfort



Indications

– **parenteral fluid replacement / nutrition:**

- ▶ patient cannot absorb nutrients through GI tract / unable to tolerate oral / enteral nutrition (diseases, trauma, surgery – preOP bowel rest, postOP)
- ▶ excessive nitrogen loss (wound infection, fistulas, abscesses)
- ▶ increased energy needs (burns, sepsis, trauma)
- ▶ nutritional deficits (nutrients - carbohydrates, fats, proteins, vitamins, minerals – electrolytes and trace elements)
- ▶ growth and development retardation



Contraindications

- TPN:

- ▶ patients with normally functioning GI tract
- ▶ well-nourished patients whose GI tract will normally function within 10 days
- ▶ patients with a poor prognosis (palliative care)




QUESTION/TASK



- ▶ Try to describe 3 different routes of intravenous application of medications...



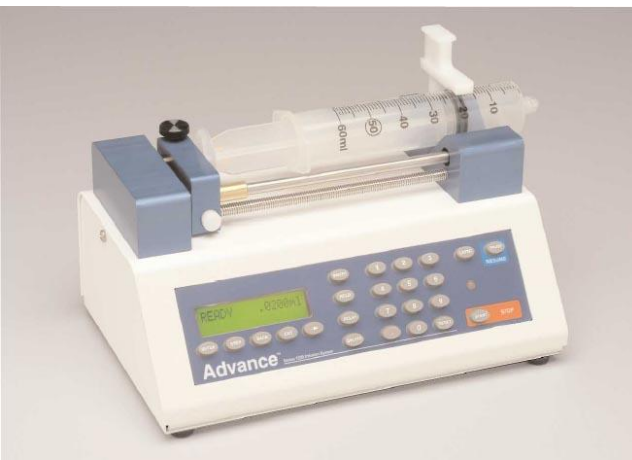
1.) i.v. push method / i.v. bolus – “directly from hand”

- ▶ concentrated dose of a drug directly into the systemic circulation (vein / existing i.v. line)
- ▶ medication usually diluted (20 ml), sterile normal saline as diluents (0,9% NaCl; ☉ F I/I)
- ▶ advantages / (dis)advantages 

2.) syringe pump / mini-infuser (intermittent application)

3.) i.v. infusion (intermittent / continual infusion by electronic infusion pump) – i.e. adding medications into small-volume / large-volume i.v. fluids/containers





I.v. infusion solutions – 3 regimens

- ▶ **multi-bottle system** (commonly used – glass/plastic bottles, bags)
 - ▶ **all-in-one system** (prepared in institutions) – water, electrolytes, glucose, lipids, amino acids, vitamins, trace elements
 - ▶ **multi-compartment system** (commercially produced, 2-3 or more compartments) – hypertonic → applied only by central application and continually
- advantages: reduction of mistakes (content / compatibility of solutions), improvement of asepsis, time management





Intravenous solutions

- ▶ sterile, with a base of non-pyrogenic water
 - ▶ categories: **crystalloids** / **colloids**
 - ▶ due to osmotic pressure (osmolarity – concentration of solutes): **isotonic** / **hypotonic** / **hypertonic**
 - *electrolyte solutions*
 - *energy solutions*
 - *lipid emulsions*
 - *solutions of amino acids*
 - *osmotic active solutions*
 - *solutions to improve acidosis*
 - *solutions to improve alkalosis*
 - *substitutive solutions (plasma / volume expanders)*
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PERIPHERAL VEINS

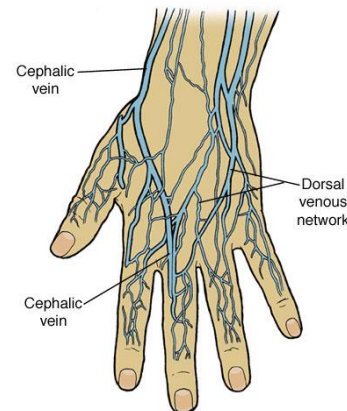
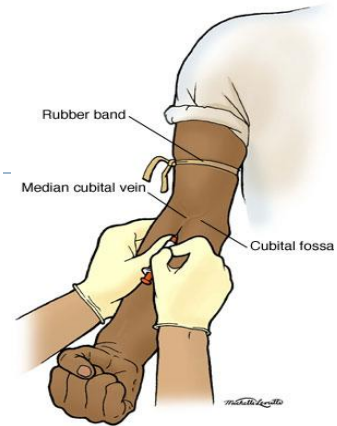
- nutritional support < 14 days; ensured by:
 - ▶ **a needle** (single-shot, stainless steel needle) –infrequently used, the risk of vein trauma, infiltration and phlebitis, risk of dislodging from the vein
 - ▶ **butterfly needle / wing-tipped needle** – dwell time in a vein is max. 6 hours
 - ▶ flexible **peripheral venous catheter / over-the-needle-catheter (ONC) / angiocath** (polyurethane, silicone, polyethylene) – dwell time in a vein is 72 hours (up to 96 hours – evidence from research studies)





Peripheral i.v. application

- ▶ **advantages:** simple, quite safe method (peripheral vascular devices insertion)
- ▶ **venipuncture sites** (blood draw, bolus injection, insertion sites for peripheral i.v. lines):
 - ▶ upper extremities – cubital space, antecubital fossa (basilic vein, cephalic vein, median cubital vein, median antebrachial vein, accessory cephalic vein), dorsal area of hand (dorsal venous arch, superficial dorsal veins)
 - ▶ exceptionally lower extremities
 - ▶ frontal and temporal superficial veins in infants



Peripheral i.v. application



- ▶ **disadvantages:**
- ▶ short-time application (inflammation, phlebitis)
- ▶ only low concentrated isotonic solutions – i.e. amino acids up to 10%, amino acids mixed with dextrose up to 5%, dextrose only up to 10% (hypertonic solutions too concentrated, causing inflammation, phlebitis, thrombophlebitis, necrosis of small-diameter peripheral veins)
- ▶ risk of circulatory overload (large volume at once)
- ▶ contraindicated in patients with site burns, sclerotic veins, arteriovenous fistula, postmastectomy arm (the risk of lymphoedema), oedematous or impaired arm or hand



CENTRAL VEINS

- intensive nutritional support for an extended period of time; ensured by:
 - ▶ **central venous catheter** – for the duration of acute care (usually up to 14-21 days)
 - ▶ **PICC** – peripherally inserted central venous catheter is alternative intermediate-length i.v. access (greater than 7 days to 3 months; some sources – can be placed as long as there are no signs of problems, even 1 year)
 - ▶ **implantable venous access / device / port** – surgically implanted, dwell time recommended is for 1500 needle sticks



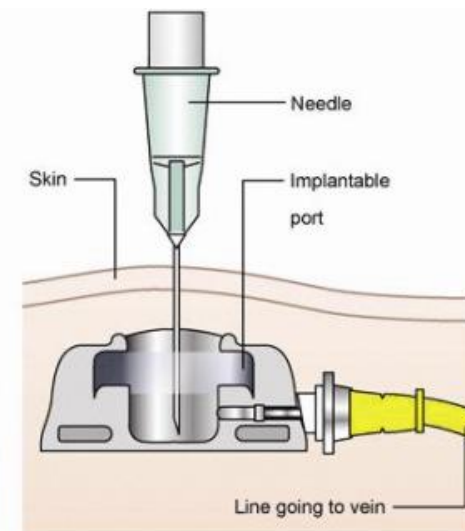
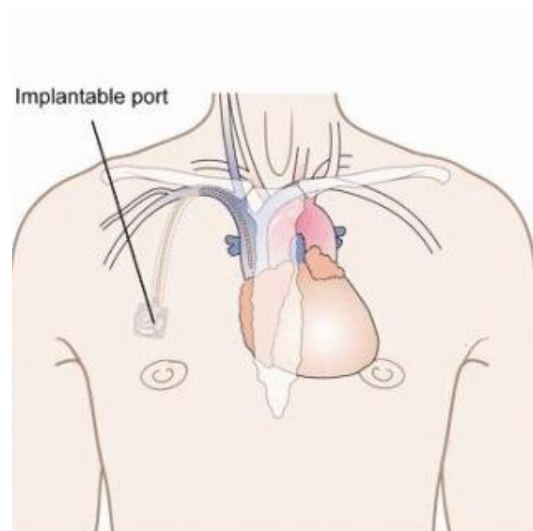
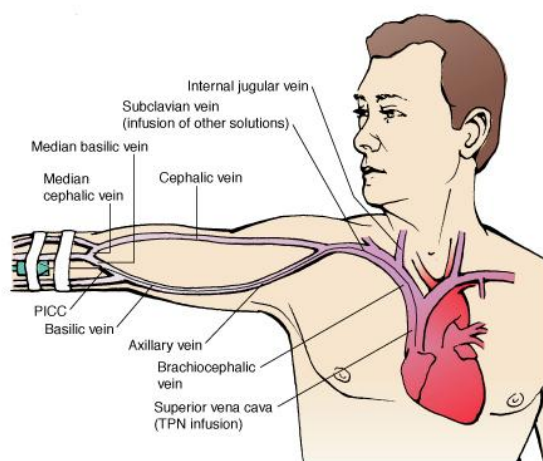
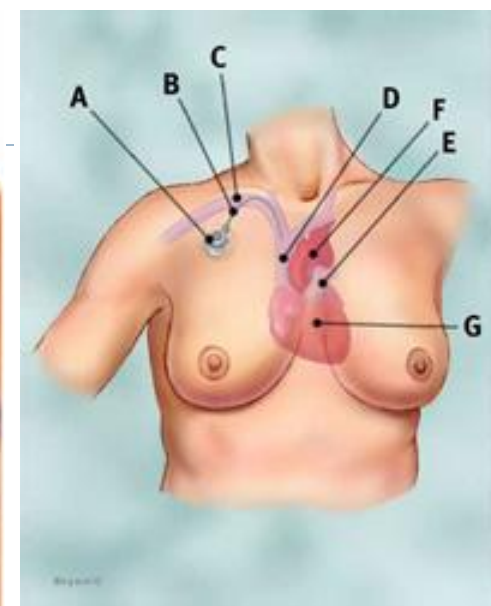
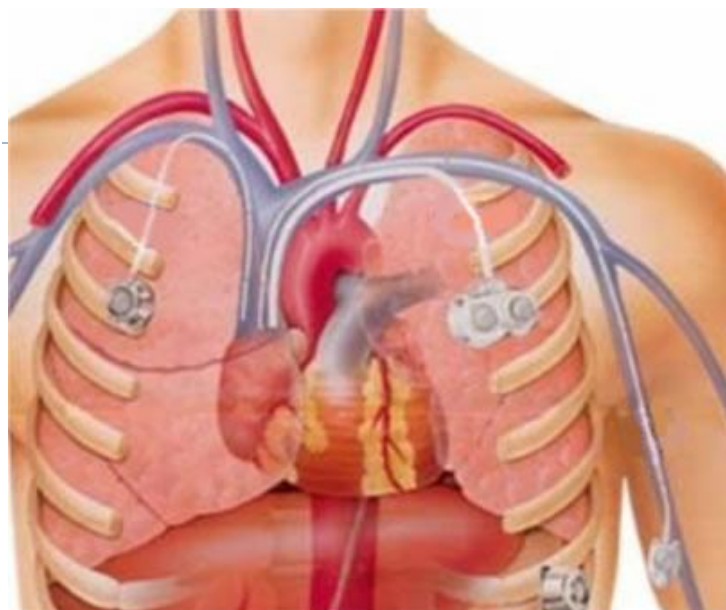


Figure 46-9 Placement of peripherally inserted central catheter (PICC).

Central i.v. application

▶ **advantages:**

- ▶ long-time application (≥ 14 days)
- ▶ no risk of circulatory overload (continual application)
- ▶ possibility to apply concentrated and hyperosmolar solutions
- ▶ no risk of phlebitis, thrombophlebitis, sclerosis of vein tissue (high-flow and large-diameter central veins)
- ▶ possibility to measure central venous pressure (CVP)
- ▶ possibility to aspirate blood samples from it



Central i.v. application

- ▶ **venipuncture sites** (puncture or surgically inserted)
- ▶ subclavian or jugular veins (distal tip of catheter in superior vena cava)
- ▶ PICC – inserted into basilic or cephalic veins just above or below the antecubital space of the right arm and threaded into subclavian vein or superior vena cava
- ▶ **disadvantages:**
- ▶ complicated way of ensuring access
- ▶ need to use full sterile-barrier precautions during central venous device insertion (strict aseptic technique – surgical sepsis, sterile field preparation)



Central i.v. application

- ▶ **risk of numerous complications** – pneumothorax, haemothorax (lung perforation), cardiac perforation, haemorrhage (puncture of subclavian artery), thrombosis, air embolism, localised infection (exit site) or systemic infection (catheter-related bloodstream infections – septicaemia/sepsis)
- ▶ need for continual infusion
- ▶ need to confirm placement of catheter tip by X-ray examination within 1 hour after insertion



QUESTION/TASK



- ▶ Describe everyday care of i.v. lines to decrease the risk of intravascular infection...



Initiating i.v. therapy – assessment

- ▶ Review **physician's orders** concerning type and amount of i.v. injection/infusion (medication – dose, frequency, fluid/solution, rate of administration).
- ▶ Assess for **clinical factors/conditions** that will respond to or be affected by i.v. fluid administration:
- ▶ patient's **fluid volume** or **nutritional status** – dry skin and mucous membranes, inelastic skin turgor (failing to return to normal position within 3 seconds after pinching), blood pressure changes, irregular pulse rhythm, increased pulse rate, decreased capillary refill, distended neck veins, peripheral oedema, body weight, behavioural changes – e.g. confusion, restlessness, auscultation of crackles or rhonchi in lungs (as for signs of deficient fluid volume / excess fluid volume); signs of nutrient deficiency (e.g. thinning hair, hair losing, poor muscle tone, etc.), laboratory values

Cont.

- ▶ **related factors** of fluid volume or nutritional changes – e.g. thirst, anorexia, nausea, vomiting, increased or decreased urine output, excessive (profuse) sweating, excessive wound drainage (evaluate fluid intake and output record), etc.
 - ▶ Assess for the following **risk factors**: child or older adult, presence of heart failure or renal failure, skin lesions, infection, low platelet count, anticoagulant therapy.
 - ▶ Determine **if patient is to undergo** any planned surgeries or blood transfusion.
 - ▶ Assess the **status of patient's venous system** – accessibility of veins, the venipuncture sites (e.g. the presence of site burns, oedematous or impaired arm or hand, sclerotic veins, presence of casts, bandages or binders), contraindications of venipunctures (e.g. arteriovenous fistula, postmastectomy arm), etc.
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Cont.

- ▶ Assess **existing i.v. insertion sites** for signs of infiltration or phlebitis.
 - ▶ Assess **patient's history of allergies** (to medication ordered, antiseptic solutions, tapes or dressing materials), assess the risk factors predisposing for latex allergy reaction – modify the selection of supplies to use the correct material.
 - ▶ Assess patient's previous or perceived **experience with i.v. therapy** and arm placement **preferences**.
 - ▶ Assess patient's **comfort level** or pain (on numeric scale of 0 to 10), symptoms of anxiety, **elimination needs** before preparing the procedure.
 - ▶ **Confirm the sterility** of all packages and sterile supplies.
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Procedures

- ▶ preparing the medication from ampoule or vial
- ▶ (assistance in) administering medications by i.v. bolus performed by single-shot needle
- ▶ preparing i.v. infusion (i.v. fluid container) – adding medication/additive into i.v. fluid container
- ▶ peripheral i.v. line insertion (venipuncture with butterfly needle /over-the-needle-catheter ONC)
- ▶ starting i.v. infusion



Complications

- ▶ adverse drug reaction to medication
- ▶ flow rate is incorrect – patient receives too little or too much fluid
- ▶ medication / infusion doesn't infuse over desired period
- ▶ sudden infusion of large volume of solution (fluid overload)
- ▶ fluid volume excess (crackles in the lungs, shortness of breath, oedema, jugular venous distension)
- ▶ fluid volume deficit (decreased urine output, dry mucous membranes, decreased capillary refill, a disparity in central and peripheral pulses, tachycardia, hypotension, shock)



Cont.

- ▶ electrolyte imbalance (abnormal serum electrolyte levels, mental status changes, alterations in neuromuscular function, cardiac arrhythmias, vital signs changes)
 - ▶ bleeding at venipuncture site (usually slow, continuous)
 - ▶ infiltration at site (swelling, possible pitting oedema, pallor, coolness, pain, possible decrease in flow rate)
 - ▶ phlebitis at site (pain, increased skin temperature, erythema along the path of vein)
 - ▶ loss of i.v. line patency (decreased or absent flow of i.v. fluid)
 - ▶ accidental removal of i.v. line
 - ▶ catheter tip is missing upon withdrawal
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Expected patient outcomes

- ▶ i.v. line is patent, intact, correctly placed
- ▶ fluids and medications are infused without difficulties
- ▶ no air bubbles are present in the syringe or in i.v. tube or infusion set/tube
- ▶ i.v. line site remains clear, free of any signs of inflammation, free of infiltration
- ▶ systemic signs of infection are absent (fever, malaise, increased white blood cell count)
- ▶ desired effect of medications is achieved without adverse reactions occurring



Cont.

- ▶ fluid and electrolyte balance returns to normal
- ▶ patient will maintain stabilized fluid volume
- ▶ patient will maintain or improve nutritional status (will meet daily intake of required nutrients)
- ▶ patient understands purpose and risks of i.v. therapy





BLOOD THERAPY



Special precautions

- ▶ prepare documentation (transfusion book, patient's record)
 - ▶ transfusion must always be warmed up (in the room temperature / warm bath) – don't apply it cold / frozen
 - ▶ transfusion set (not infusion one) should be applied as closely to transfusion as is possible and changed with every new unit
 - ▶ complete pre-transfusion tests must always be performed
 - ▶ transfusion has to be applied till 4 hours after being removed from refrigerator (till 2 hours – erythrocyte concentrate), has to be completed within 4 hours of initiation
 - ▶ empty bag with transfusion set should be stored in a refrigerator for 24 hours
 - ▶ signs of adverse reactions to blood transfusion have to be monitored
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Pre-transfusion tests

- ▶ blood pressure, pulse, temperature measurement (the same after the transfusion)
- ▶ chemical investigation of urine sample (the same after the transfusion)
- ▶ big cross-matching – immunohaematological test in laboratory (sending 5ml of native venous blood of the patient) – to prepare compatible transfusion unit for the patient (as for blood group and Rh system)
- ▶ small cross-matching – “sangvitest” in the ward (the blood of donor from transfusion bag, the blood of patient + diagnostic serums)
- ▶ biological test at the patient’s bedside



Adverse reactions to transfusion

- ▶ haemolytic
- ▶ febrile (pyretic)
- ▶ allergic
- ▶ circulatory overload
- ▶ sepsis (bacterial – toxic)



Questions?

► Thank you for your attention...

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