

INJECTIONS

Injections

- Invasive, painful administration of substances (medicaments)
- Risk of injury, infection, pyrogenic effect
- High, even 100% and relatively stable bioavailability of administered substances

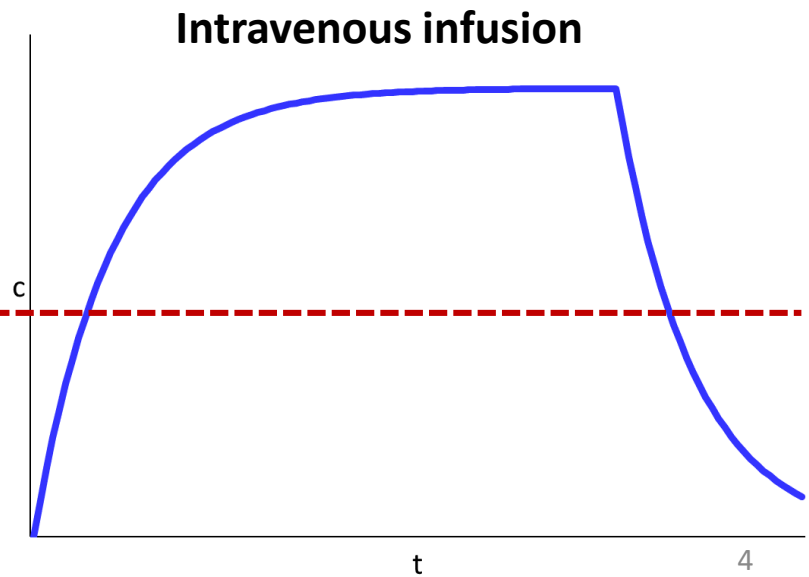
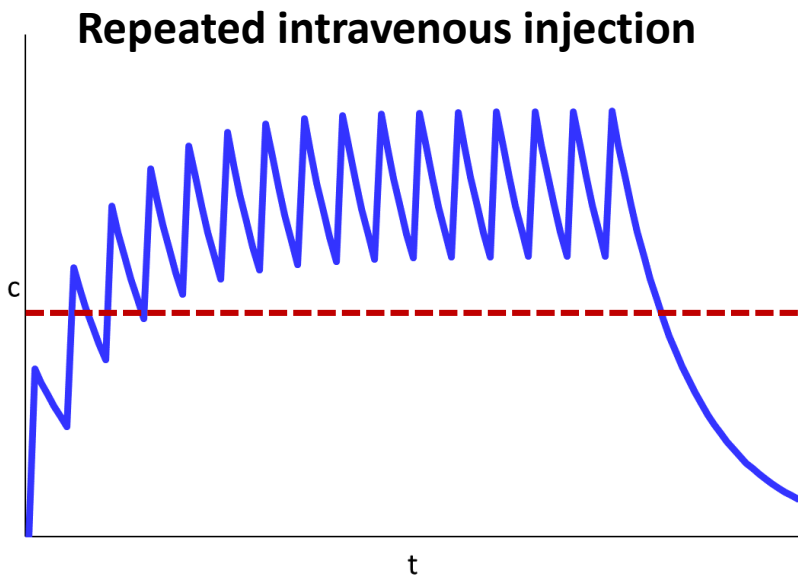
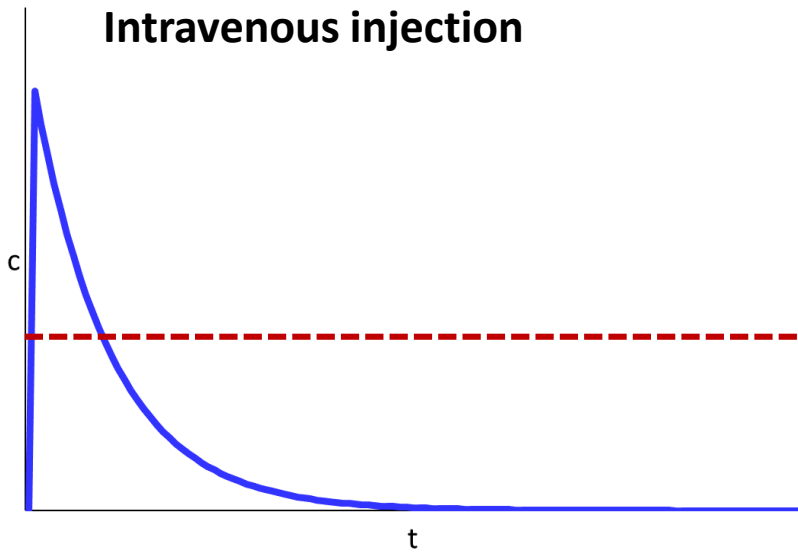
Injections for systemic administration

- intravenous (i.v.)
- intramuscular (i.m.)
- subcutaneous (s.c.)
- intraperitoneal (i.p.)
- intramedullary (into the bone marrow)
- intracardial (i.c.)

Injections for local administration

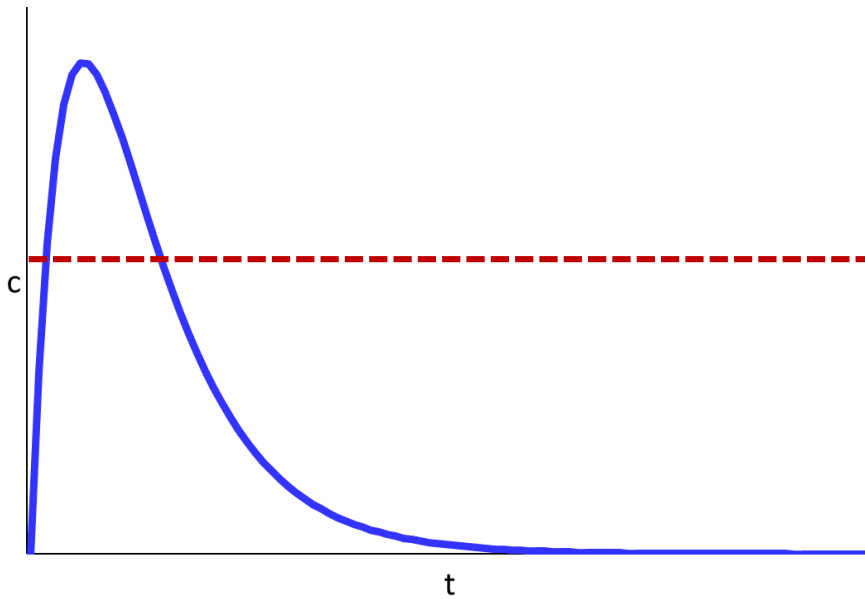
- intraarterial (i.a.)
- intraarticular
- periarticular
- periorbital
- intradermal
- intrathecal
- epidural
- etc.

Pharmacokinetics of injection administration

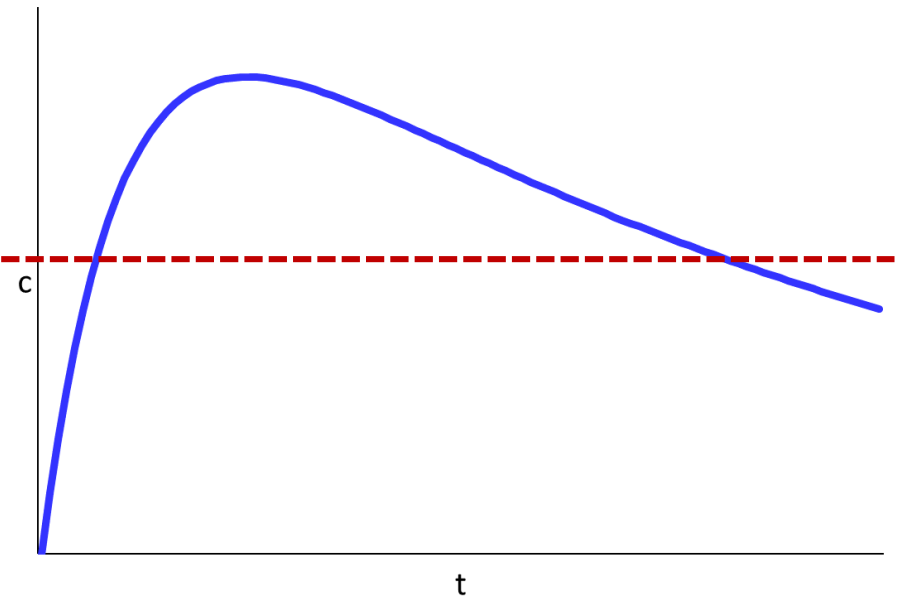


Pharmacokinetics of injection administration

Intramuscular or subcutaneous injection



Intramuscular inj. of a depot preparation



----- effect threshold

Specific features of individual injection types

Intravenous

- The fastest effect onset - about 2 min
- Solutions, uncommonly microemulsion
- No suspensions, no emulsions - risk of embolism
- Hypertonic and irritable solutions can be injected slowly into a larger vein.
- Concentration wave → risk of transiently excessive concentration
- Antibiotics, general anesthetics

Intramuscular

- Fast (10 - 15 min) and short effect or depot preparations
- Isotonic solutions, suspensions, emulsions, oil-based substances
- No irritable substances → necrosis
- Antibiotics, general anesthetics, vaccination, depot preparations

Specific features of individual injection types

Subcutaneous

- Limited volume - up to 2 ml
- Non-irritable substances only
- Middle time of effect onset (15-20 min) and effect with strong dependence on recent level local blood perfusion
- Low-molecular weight heparin, insulin, local anesthetics, vaccination

Intraperitoneal

- Alternative to i.v. injection in small laboratory animals

Intramedullar

- Alternative to i.v. injection used in critical situations

Specific features of individual injection types

Intracardial

- Only for resuscitation
- Not better outcome than i.v. administration (a large vein, a high volume, „flushing“ with 20-40 ml of physiological saline)

Intraarterial

- To achieve a high concentration in a specific organ
- E.g. cytostatics, contrast substances, fibrinolytics

Dose calculation

dosage d (mg/kg)

2 mg/kg

concentration c (mg/ml)

50 mg/ml (5%)

body weight m (kg)

75 kg

administered dose A (mg) = ?

administered volume V (ml) = ?

$$A = m \times d$$

$$A = 75 \times 2 = 150 \text{ mg}$$

$$V = A/c$$

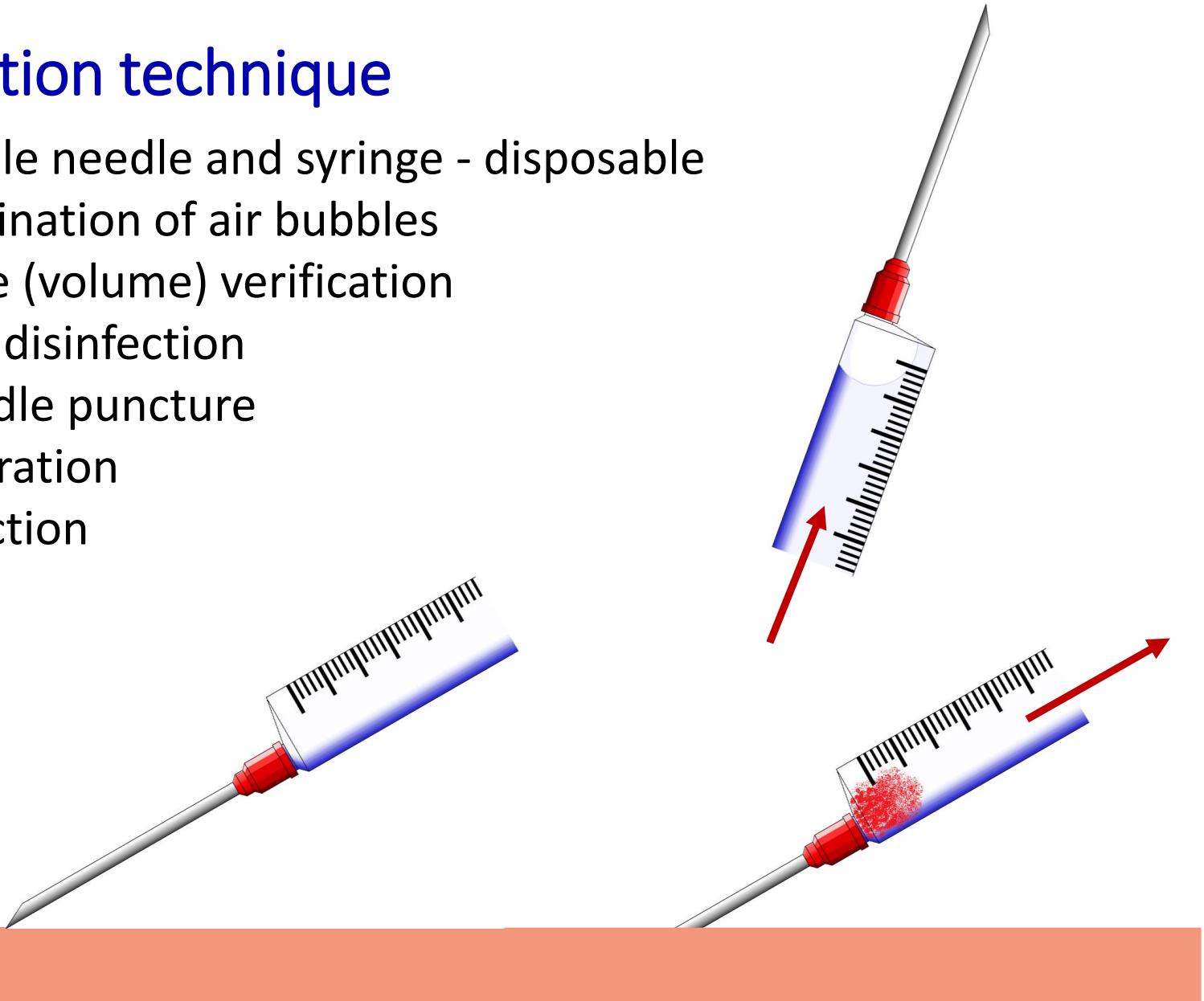
$$V = 150/50 = 3 \text{ ml}$$

$$V = m \times d / c$$

$$V = 75 \times 2 / 50 = 3 \text{ ml}$$

Injection technique

- Sterile needle and syringe - disposable
- Elimination of air bubbles
- Dose (volume) verification
- Skin disinfection
- Needle puncture
- Aspiration
- Injection



Air embolism - the air in the vein

- intravenous injection - small volume
- intravenous infusion
- cervical vein injury
- intracranial sinus injury
- decompression disease (air also in arteries and tissues)

Air bubbles carried into the right heart by the blood

- Dependent on the air amount and speed of its influx into the vein

- 1) passage through the heart into the pulmonary artery → right heart overload
- 2) the right atrium and ventricle filled with air → sound phenomena, the heart compresses the air instead of pumping the blood → circulation arrest

more than 20 ml → manifestation, dangerous

100 - 200 ml → death

Air embolism - air in the artery

- intraarterial injection
 - air in a vein → the right heart; in the case of septal defects + pulmonary hypertension → the left heart → arteries
 - cofferdam disease
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- Even small bubbles occlude smaller arteries → ischemia
 - Coronary arteries, the brain!
 - Volume of few milliliters or even less than 1 ml
→ injury of an organ

THE END