

### Indication

An arterial blood-gas analysis (BGA) serves, among other things, to test the gas-exchange function of the lung and is performed above all on patients with respiratory distress and in general on intubated patients to correctly adjust the respiratory parameters or to set them to current requirements. This requires determining the oxygen partial pressure ( $PO_2$ ), carbon dioxide partial pressure ( $PCO_2$ ), and oxygen saturation ( $SaO_2$ ).

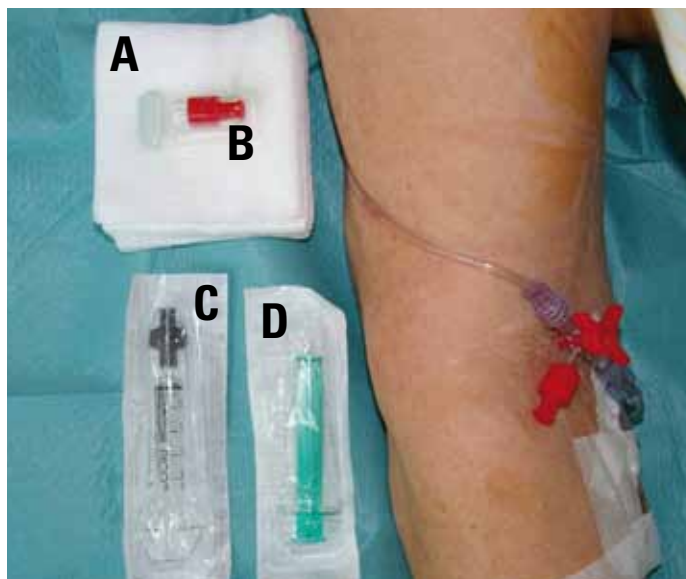
In addition, the acid-base balance can be established using the pH value, the concentration of standard bicarbonate ( $HCO_3^-$ ), and the base excess (BE) to check for any possible deviation. Most measuring instruments also simultaneously provide the concentration of the electrolytes sodium, ( $Na^+$ ), potassium ( $K^+$ ), calcium ( $Ca^{++}$ ), and chloride ( $Cl^-$ ). The reference values for the most important BGA parameters are shown in Table 53.1 (see also pp. 115 and 120). These values differ among different laboratories.

### Preparation

If your patient is being ventilated and an indwelling arterial catheter has already been placed (see Chap. 19), you will only need some swabs (A), a sterile cap (B), a heparinized BGA syringe (C), and a normal 2mL or 5mL syringe (D) for aspiration (Fig. 53.2). Heparinized syringes can be obtained in a specialist shop, or you can prepare one yourself by sterilely drawing up some heparin solution in the syringe and then discarding it so that the inner surface of the syringe is moistened with heparin.

Oxygen partial pressure	$PO_2$	75 - 98 mm Hg 10 - 13 k Pa
Carbon dioxide partial pressure	$PCO_2$	35 - 45 mm Hg 4.7 - 6.0 k Pa
Oxygen saturation	$SaO_2$	95 - 97 %
pH	pH	7.38 - 7.42
Standard bicarbonate	$HCO_3^-$	20 - 28 mmol/L
Base deviation	BE	-2 - +2 mmol/L
Sodium	$Na^+$	135 - 150 mmol/L
Potassium	$K^+$	3.5 - 5.0 mmol/L
Calcium	$Ca^{++}$	2.2 - 2.6 mmol/L
Chloride	$Cl^-$	98 - 112 mmol/L

**Table 53.1** Reference values for a BGA [11.1].



**Fig. 53.2** Preparation

### Contraindications

If a patient has no indwelling arterial catheter, you will have to tap the radial artery or the femoral artery (p. 50). Possible contraindications are hemorrhagic diathesis, anticoagulation therapy, or a skin infection at the intended puncture site.

### Complications

If one of the above-mentioned arteries is to be tapped, a greater danger of infection generally exists in the groin. For this reason, puncture of the femoral artery is not recommended, especially because compression following puncture is more difficult here than over the radial artery. A post-puncture hematoma is more likely to occur in the groin than in the wrist. It is preferable to tap the radial artery on the non-dominant hand.

Before tapping the radial artery, you should perform an Allen test (p. 116) to assure sufficient collateralization via the ulnar artery in case the radial artery thromboses. If the skin becomes pale due to a vascular spasm following the mechanical irritation of the needle, injecting 10-20 mg of a 1% solution of lidocaine through the needle in place can resolve the arterial spasm.

Now open the tourniquet (↙) slowly; do not let it snap (Fig. 72.1). Then place a swab between the skin and the opening of the cannula. When you remove the inner steel cannula (→), immobilize the indwelling cannula again (↗ ↘ in Fig. 72.2) and compress the vein at the proximal end of the line (↓) to prevent retrograde blood flow (Fig. 72.3). Dispose of the steel cannula properly in a waste container provided for this purpose.



Fig. 72.1 Release tourniquet

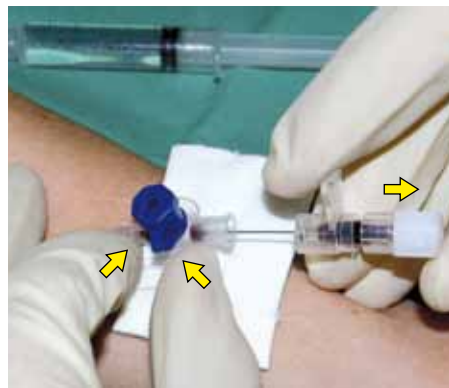


Fig. 72.2 Withdraw steel cannula.

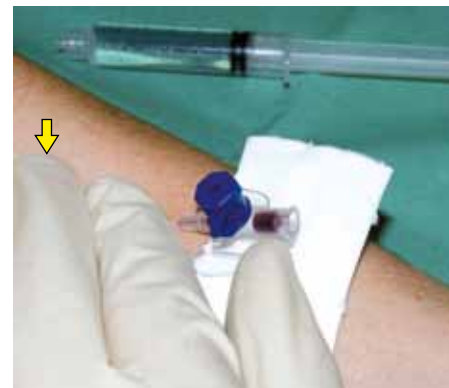


Fig. 72.3 Compress vein

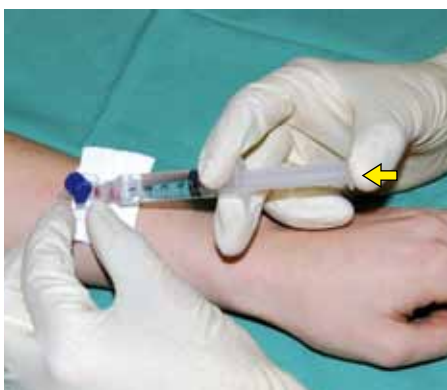


Fig. 72.4 Test injection



Fig. 72.5 Drains freely?

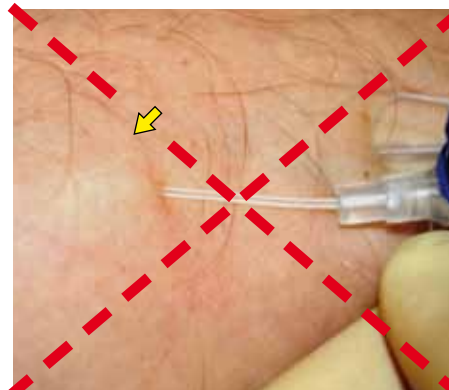


Fig. 72.6 Or extravasation?

Then connect the syringe with isotonic saline solution by screwing it on clockwise and quickly perform a test injection (↙) of 2-5 mL (Fig. 72.4): Make sure that the fluid can drain quickly and freely and that the vicinity of the cannulation site (↘) shows no signs of extravasated fluid (Fig. 72.5). Fig. 72.6 shows the typical bulge (↘) resulting from a malpositioned cannula.

Then the indwelling cannula is fixed to the skin with any type adhesive strips or tape (Fig. 72.7) and a sterile bandage, ideally a transparent one (Fig. 72.8). This will allow you to detect any erythema without changing the bandage and thus sooner (Fig. 72.9a) than would be possible with a nontransparent bandage (Fig. 72.9b).



Fig. 72.7 Fixation with adhesive strips.



Fig. 72.8 Transparent bandage

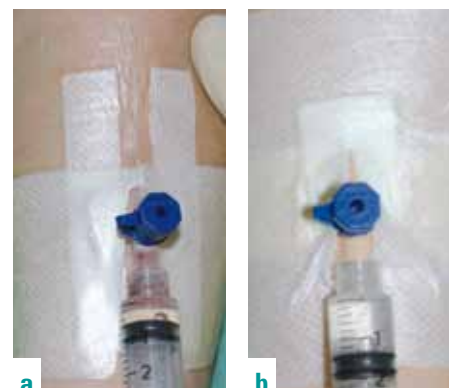


Fig. 72.9 Protective dressing

Now have a swab ready ( ↗ ) in your left hand and withdraw the syringe and needle ( ↑ in Fig. 84.1). Then press the swab tightly against the injection site and apply a circular motion ( ↻ ) to help distribute the medication (Fig. 84.2). Finally, apply an adhesive bandage to protect the injection site (Fig. 84.3).



Fig. 84.1 Remove syringe and needle.



Fig. 84.2 Compression



Fig. 84.3 Protective bandage

### Alternate Injection Sites

The deltoid region of the proximal upper arm and shoulder is a suitable alternate site especially for vaccinations and for injecting volumes less than 2 mL (Fig. 84.4). Make sure that the seated patient can allow the arm to hang down and relax (Fig. 84.5). Then palpate the thickest portion of the deltoid muscle ( ↓ ) which you can mark with your fingernail (Fig. 84.6). After meticulous spray disinfection (Fig. 84.7) you can compress the muscle slightly with the left hand ( ↗ ↘ ) to better insert the needle ( ← in Fig. 84.8) into the „thicker“ muscular belly. Do not advance the needle too far (Fig. 84.9) and remember to aspirate ( ↘ in Fig. 84.10) before you inject ( ↘ in Fig. 84.11) the medication. The same precautions apply as on p. 82.

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Fig. 84.4 Deltoid region



Fig. 84.5  
Arm relaxed



Fig. 84.6 Mark

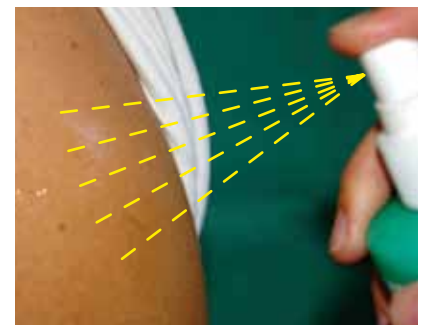


Fig. 84.7 Disinfection

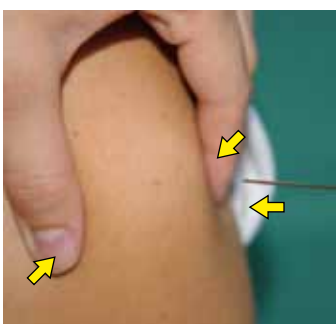


Fig. 84.8 Slight  
compression



Fig. 84.9 Insert needle  
(not too far).



Fig. 84.10 Aspiration



Fig. 84.11 Injection