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DOCTORS IN TRAINING

Tips for Trainees & Foundation Doctors in ICU

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Abstract

A placement within critical care provides valuable experience for Intensive Care Medicine trainees and those training in other specialties. However, the environment is different from what you have previously experienced on the wards and can initially seem daunting. This guide aims to help demystify some of the critical care jargon so that you can feel more prepared for your time in the intensive care unit (ICU).

Key words: critical care; intensive care; life support; basic cardiac

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What is ICU?

Intensive care is where the sickest patients in the hospital are treated. The main difference from the ward setting is that there is a significantly higher staff-to-patient ratio; with patients having one-to-one nursing care and more intensive input from the whole multidisciplinary team (Faculty of Intensive Care Medicine, 2022; Gomersall et al, 2016). Patients are closely monitored and therefore, can receive more aggressive treatments that can't be delivered safely on a ward. However, despite the plethora of machines that go 'bong', intensive care generally aims to normalize and support the patient's own physiology, allowing them to recover from their illness.

Depending on the hospital there may be a single intensive care unit (ICU) or several different units with subspecialities. These may be for specific patient groups, such as adult and paediactric ICU's. Alternatively, they may be organ or illness-specific; such as neuro, cardiac, liver or surgical ICU's. Subspecialist ICU's tend to be in specialist centers (often linked to surgical specialties) where they have specific monitoring and tests available for their patient cohorts. Grouping these patients, with less common pathologies, together leads to better outcomes from the familiarity of treating their condition more frequently. The specifics of how each sub-specialist ICU works are beyond what will be covered in this article. However, the vast majority of what is covered here will still apply to all intensive care settings.

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Drugs

The following are some medications that are commonly used within ICU but are rarely used outside of a higher dependency area. These are primarily for cardiovascular support and are summarized in the Table 1 below.

Metaraminol is an alpha-1 agonist, it can be administered peripherally and supports blood pressure by causing peripheral vasoconstriction (Scarth and Smith, 2016). It is useful in patients with low blood pressure due to vasodilation, for example, during an inflammatory response or for patients on vasodilating drugs, such as sedatives or an epidural.

Noradrenaline is also an alpha-1 agonist with additional chronotropic action (Scarth and Smith, 2016). It causes peripheral vasoconstriction but also makes the heart pump harder. It is more potent than metaraminol and needs to be given centrally. Noradrenaline is given as an infusion and titrated to blood pressure and other physiological parameters. A mean arterial pressure (MAP) >65 mmHg is a common target (Society of Critical Care Medicine, 2021). The main undesirable side effect is peripheral ischemia with increased doses.

The second-line treatment to support blood pressure in severe sepsis is Vasopressin, also known as an antidiuretic hormone (Society of Critical Care Medicine, 2021). It has two primary functions; it increases water reabsorption in the kidneys and causes vasoconstriction of arterioles (Scarth and Smith, 2016). For patients with significant neurological injuries, vasopressin is often the first-choice treatment for blood pressure support, as it will also treat neurogenic diabetes insipidus.

The other class of cardiovascular drugs frequently used are antiarrhythmics. Amiodarone is a potent drug that should be given centrally. It is used to treat arrhythmias of both ventricular and atrial origin (Scarth and Smith, 2016). It works by prolonging the cardiac action potential and is commonly used in ICU, often for rate control or cardioversion of atrial fibrillation.

Monitoring & Lines

To safely administer the potent drugs discussed, continuous and invasive monitoring is utilized in higher-dependency beds. The majority of patients in intensive care will have an arterial line, as shown in Fig. 1. These are placed, under sterile conditions, into an artery. They give beat-to-beat monitoring of blood pressure and offer easy access to regular arterial blood samples.

Each patient's fluid balance is closely monitored. Intravenous (IV) and oral intake are recorded. Urine output is measured, often via a catheter, along with all other fluid output, e.g., from drains, Nasogastric (NG) tubes or stomas. Don't forget to consider insensible losses, especially in febrile patients.

A central venous catheter (CVC) is a multi-lumen line placed via the internal jugular, subclavian or femoral vein with the tip sitting in the vena cava, as seen in Figs. 2,3. These allow drugs which may be toxic to peripheral veins to be reliably given directly into the central circulation. Following the insertion of a CVC, its position should be checked by either transducing the line to check for a venous waveform or taking a venous blood gas and comparing it to an arterial sample. Ide

Table 1. Summary of some intensive care cardiovascular drugs.

Drug	Indication	Mechanism of action	Dose	Precautions
Metaraminol	Hypotension	Alpha-1 agonist	0–10 mg/hr (0–20 mL/hr)	
Noradrenaline	Hypotension/Septic shock	Alpha-1 agonist + weak Beta-1 agonist	0–1.0 mcg/kg/min	Peripheral ischaemia
Vasopressin	2nd line septic shock/hypotension secondary to brain injury	Arteriole vasoconstriction + free water reabsorption	0–6 IU/hr	Peripheral ischaemia Bowel ischaemia
Amiodarone	Cardiac arrhythmia	Voltage-gated K^{+} and Ca^{++} Channel blocker	300 mg loading + 900 mg infusion	Hypotension, bradycardia, thyroid disease, pulmonary fibrosis

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ally, both should be undertaken to ensure the line is not cannulating an artery. A chest X-ray should be taken to check the position of the line and to rule out complications, such as pneumothorax or malposition (Tempe and Hasija, 2017). The tip should sit in the right atrium.

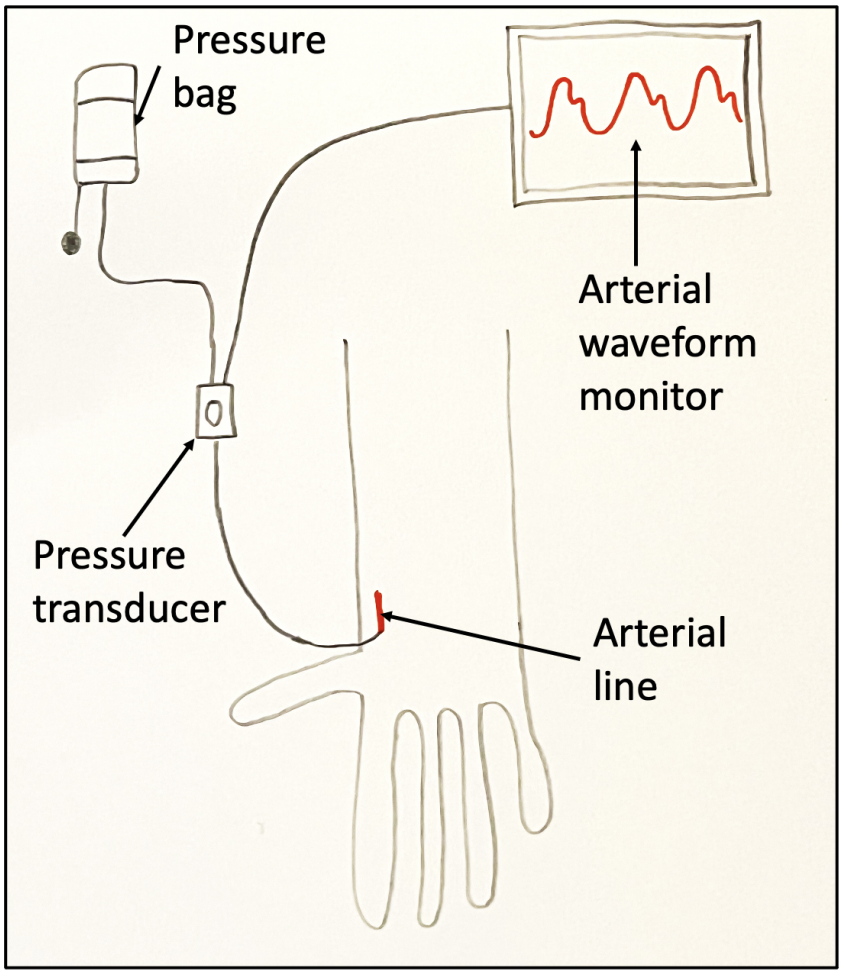

Fig. 1. Arterial line in left radial artery with attached transducer showing an arterial waveform on a monitor (Drawn by hand with labels added in Microsoft Office Version 16.78.3, Microsoft, Redmond, WA, USA).

Cardiac output monitoring can be done via an oesophageal Doppler or an arterial line calibrated with either temperature or lithium. These are used to aid in the titration of IV fluids, vasopressors and inotropic agents.

Life Support Machines

There is no such thing as a life support machine per se. In practice, ICU has a collection of machines that can support individual organs. Ventilators are one of the most daunting and confusing of these machines. An excellent guide to invasive ventilation is The Intensive Care Foundation: Handbook of mechanical ventilation (Camporota et al, 2015). Ventilation modes can be broadly split into control modes and support Modes. Control modes are used when the patient is not spon-

Table 2. Common baseline ventilator settings (Camporota et al, 2015; Nickson, 2024; The Acute Respiratory Distress Syndrome Network, 2000).

• PEEP of 5 cmH_2O normally. Zero initially in asthma and higher (8–10 cmH_2O) in pulmonary oedema or ARDS
• Respiratory rate 14–20 per minute
• Tidal volume of 6–8 mL/kg (based on ideal body weight)
• Inspiration:Expiration (I:E) ratio 1:2
• FiO2: start high and reduce to be safe in acutely hypoxic patients
• Plateau airway pressures <30 cmH_2O

PEEP, Positive End Expiratory pressure; ARDS, acute respiratory distress syndrome; FiO2, fraction of inspired oxygen.

taneously breathing. Whereas support modes are used to support a patient's spontaneous breathing. Either mode can be delivered by a set pressure or a set volume. Some typical baseline ventilatory settings for most patients in a general ICU are summarized in Table 2.

Another large and daunting machine often used in ICU is Renal replacement therapy (RRT) for kidney support. Acute indications for RRT are renal failure that has led to pulmonary oedema, hyperkalaemia or acidosis, which are not responding to medical therapy (KDIGO, 2012). It can also be used for the removal of toxins in certain drug or substance overdoses. RRT is administered centrally via a vascath, which is similar to a central line but with a larger caliber as a greater flow is required to remove, filter and return blood.

Feeding is a crucial part of recovery when in ICU. Once patients are stabilized efforts should be made to initiate feeding. This is ideally done via the enteral route, but if this is not possible or if absorption is poor can be supplemented intravenously with parenteral nutrition (PN). In most cases this is guided by dieticians, taking into account calorific requirements and nutrient deficiencies. If there is no absorption via the enteral route then PN should be started within 3–7 days (Singer et al, 2019).

Sedation

To allow patients to tolerate some treatments in ICU sedative drugs are used. For example, intubated patients are sedated both for tube tolerance and patient comfort (Grounds et al, 2014). Propofol is a hypnotic drug also used in anaesthesia (Scarth and Smith, 2016). An excellent drug for sedation but has a depressive effect on the cardiovascular system. Propofol is a good sedative but is rarely used as a single agent. Alongside this, opiates are often used as co-agents for both analgesia and anxiolysis. Fentanyl, morphine, alfentanil and remifentanil are all opiates used in ICU. Each is subtly different and may be switched during weaning to help the patient clear sedative drugs. It is worth remembering that opiates will depress respiratory drive, which can be a help or a hindrance depending on a patient's clinical situation.

An alternative class of hypnotics are benzodiazepines. These can be given by infusion in addition to, or instead propofol as a sedative agent. While this gives

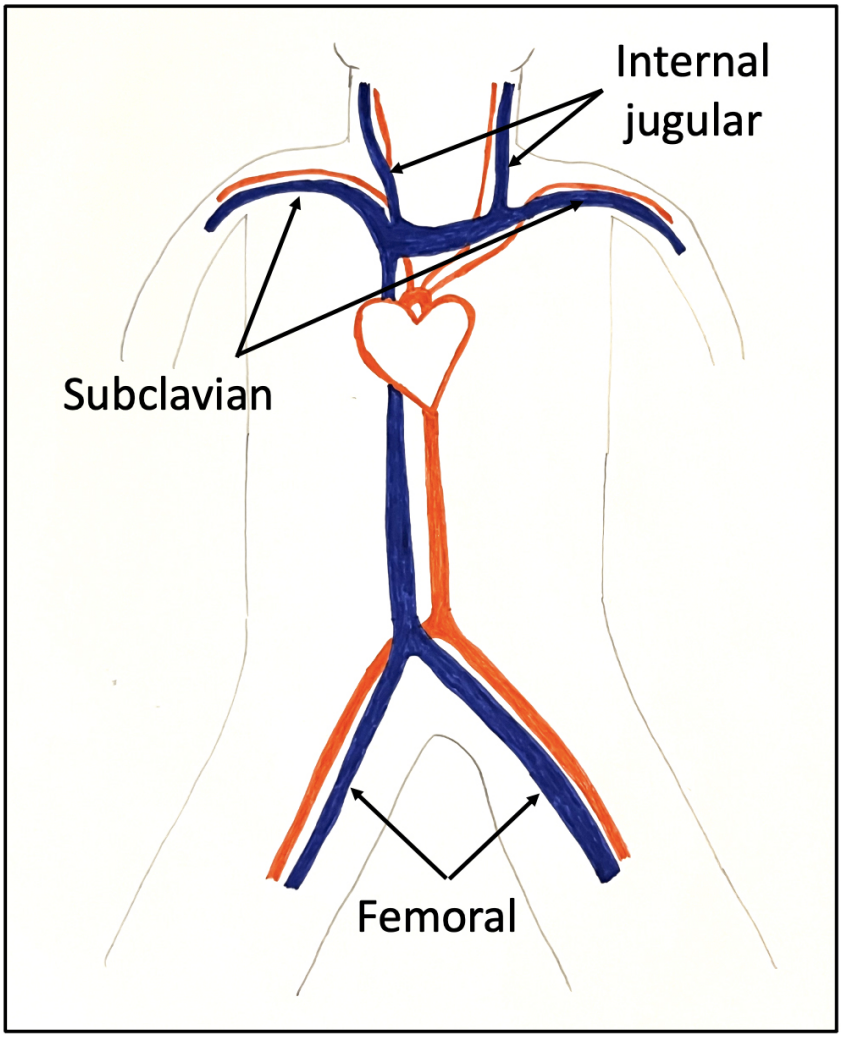

Fig. 2. Potential sites for central venous access (Drawn by hand with labels added in Microsoft Office Version 16.78.3, Microsoft, Redmond, WA, USA).

a 'less clean' (more addictive, increased side effect profile, not metabolized or excreted as effectively) sedation they generally offer more cardiovascular stability and are useful for patients who are expected to require prolonged sedation (Scarth and Smith, 2016).

Another, weaker class of sedatives are the Alpha-2 agonists, such as clonidine or dexmedetomidine. These stimulate alpha-2 receptors causing a sedative and analgesic effect. The most common side-effect of alpha-agonists is hypotension.

Most doctors have used the glasgow coma scale (GCS) score to assess consciousness. This is only validated in head injuries and often isn't a useful measure of sedation in ICU. Look up the Richmond Agitation and Sedation Score (RASS) to assess the level of sedation for ICU patients (Grounds et al, 2014). Almost all sedative drugs used in ICU can 'accumulate' in the body over time, leading to prolonged length of stay. To assess neurological function and reduce length of stay most ICU patients should have sedatives held daily. These can be recommenced, once the patient gets 'lighter'.

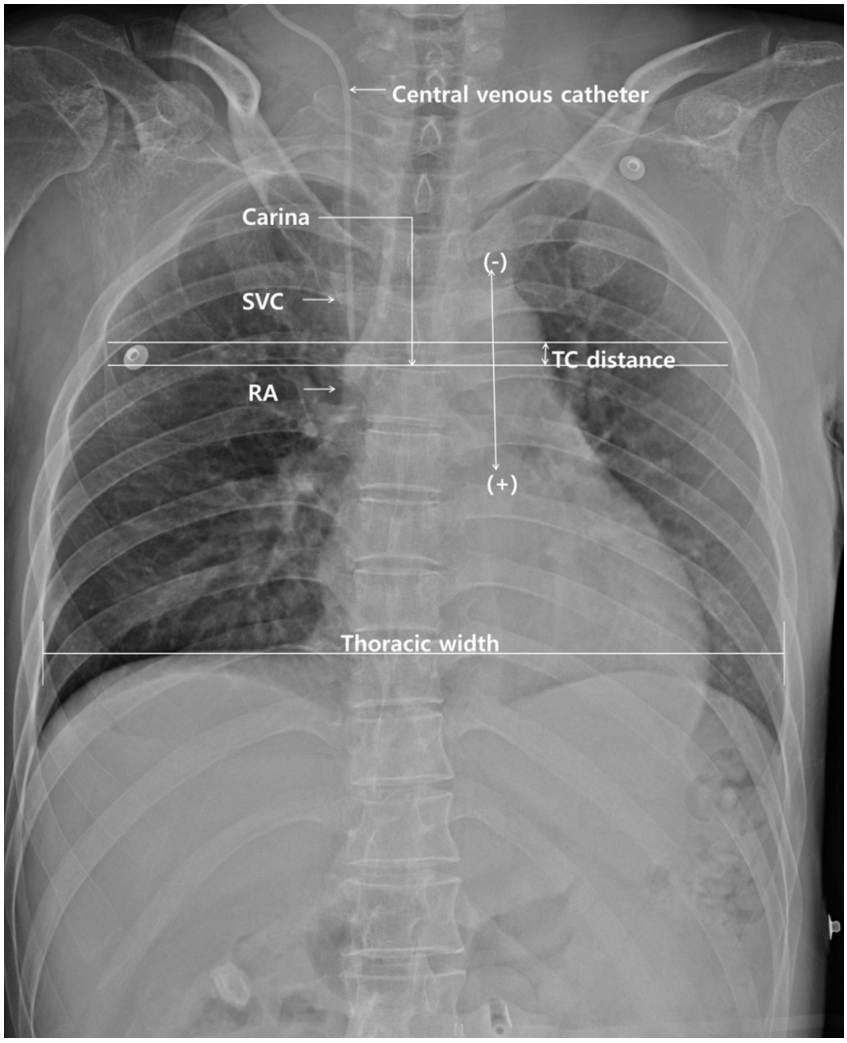

Fig. 3. Chest X-ray with central venous catheter tip correctly placed (Kang et al, 2021). Reproduced with permission from [Minwoo Kang], [BMJ Open]; published by [BMJ Publishing Group Ltd.], [2021]. SVC, superior vena cava; RA, right atrium; TC, tip-to-carina distance. +/– are upper and lower limits for position.

Referrals

If you are taking referrals for ICU you will want to find out:

• Why the patient has been referred, what are they being treated for and what is the specific problem that ICU can help treat?

• The patient's background; co-morbidities and functional status day-to-day.

• How unstable is the patient and how quickly does the referring team need help?

Discuss referrals with senior colleges and consultants. They may ask you to go and review before feeding back further. This is a great learning opportunity. When taking referrals always remember that if someone is referring to ICU it is because they are worried about a patient and want help. Give them time to explain their concerns and always aim to help. Even if the patient isn't appropriate for escalation, ICU can usually offer some treatment advice. If it is decided that a patient is not

for ICU, try to take the time to explain the reasoning to the referring team. This is a good teaching opportunity for both yourself and them.

Finally

Aim to do a BASIC course which is an excellent introduction to critical care (Gomersall et al, 2016). Take the opportunity to place lines as these are also used on medical high dependency unit (HDU) or cardiac care unit (CCU). If nothing else you will be much better able to help someone else place a line quickly for a sick patient if you know how they are inserted.

Ask questions. People are generally keen to teach or to explain interventions. Get stuck in!! This is the perfect place to practice assessing and treating the sickest patients while learning the limits of what modern medicine can offer to patients. Hopefully, these lessons will help you for the rest of your career. Finally, enjoy yourself!

If you would like more information or access to guidelines, the Intensive Care Society or Faculty of Intensive Care Medicine websites are good places to start. There is also a wide selection of e-learning modules on the e-learning for health website.

Key Points

- Intensive care differs from other areas of the hospital because it has much higher staffing ratios with more input for patients from a broad multidisciplinary team (MDT).
- This allows the safe use of potent drugs and machines that aim to support or replace organ functions normalizing physiology while a patient recovers from an acute illness.
- To help facilitate this invasive monitoring and access if often required, with some patients also requiring sedation.
- Good basic care and attention to detail are the foundation of excellent intensive care.

Curriculum Checklist

This article addresses the following requirements of the general internal medicine curriculum:

- Demonstrates prompt assessment of the acutely deteriorating patient, including those who are shocked or unconscious.
- Formulates an appropriate diagnostic and management plan, taking into account patient preferences, and the urgency required.
- Demonstrates appropriate and timely liaison with other medical specialty services when required.

Availability of Data and Materials

Not applicable.

Author Contributions

MO was responsible for designing the research study and analysing the data. MO also contributed to drafting the manuscript and made editorial revisions of important content. The author has reviewed and approved the final manuscript, actively participated in the work, and agreed to be accountable for all aspects of the study.

Ethics Approval and Consent to Participate

Not applicable.

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This article is intended as an introduction to intensive care and is not an exhaustive guideline for the treatment of ICU patients. Local protocols, professional judgement and senior support should all be used when treating patients.

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Conflict of Interest

The author declares no conflict of interest.

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