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Pediatric intensive care unit for beginners

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Abstract
Working in a service so specialized as the pediatric intensive care unit requires training and experience. Hospitalized patients have serious prognoses in addition to a high risk of complications. The objective of this guide is to address those key concepts to obtain the basic competencies for safe and quality care.
Key words: Nursing. Guide. Intensive care unit. Pediatrics.

Unidad de cuidados intensivos pediátricos para novatos

Resumen
Trabajar en un servicio tan especializado como la unidad de cuidados intensivos pediátricos requiere formación y experiencia. Los pacientes ingresados tienen pronósticos graves además de un alto riesgo de presentar complicaciones. El objetivo de esta guía es abordar aquellos conceptos claves con tal de obtener las competencias básicas para una atención segura y de calidad.
Palabras clave: Enfermería. Guía. Unidad de cuidados intensivos. Pediatría.

Introduction

In 1983, the Guidelines for Pediatric Intensive Care defined pediatric intensive care units (PICUs) as: "a hospital unit that provides treatment to pediatric patients with a wide variety of illnesses of a potentially lethal nature, including those with critical conditions and those that require special medical or surgical treatment".[1]

Care must be provided continuously twenty-four hours a day by a medical team with special competence in intensive care medicine. Adequate training of medical and nursing staff is essential to ensure the quality of intensive medical care and patient safety in the PICU.[1] This review aims to describe the key nursing competencies in this unit, from cardiorespiratory arrest to the most basic care of the patient's hygiene.

Cardiorespiratory arrest

In pediatric patients, begin with cardiopulmonary arrest (CPA), causing tissue hypoxia and cardiac arrest. The chain of survival is a series of steps to follow when a CPA occurs. Its links include early detection, alerting emergency teams, rapid establishment of quality cardiopulmonary resuscitation (CPR), early defibrillation, advanced life support, and post-resuscitation measures. The recommendation is to start CPR with 5 rescue ventilations, then we will evaluate the signs of circulation. If there are no signs of life or pulse (<60 rpm in infants and children), we will begin chest compressions combining them with ventilations (15/2).[2]

In PCR, the prognosis improves with quick action, so having the drugs ready will save us time and errors. Epinephrine is the drug of choice in CPR, the dose remains at 0.01 mg/kg. For shockable rhythms in CPR, we will use amiodarone. Lidocaine (1 mg/kg; maximum 100 mg) is an alternative to amiodarone. Atropine is not considered a CPR drug and its use will be restricted to bradycardias or vagal blocks. Regarding sodium bicarbonate, the dose is 1 mEq/kg diluted in the medium with physiological saline. There is no evidence to show that it improves the results of CPR and we should avoid its routine use. Its use is indicated in cases of severe metabolic acidosis. Finally, 10% calcium chloride is diluted in the medium; its use is for hypocalcemia, hyperkalemia, hypomagnesemia, and poisoning due to calcium blockers.[2]

Routes of administration

Central venous cannulation is one of the most common procedures today, as it facilitates resuscitation, nutritional support, and vascular access.

Catheter lumens have different characteristics. The distal lumen is larger in caliber, it will be used for specific medications, mainly those infused at high flows and high density such as colloids, or for blood transfusions. In addition, it is also used for monitoring central venous pressure (CVP). The

proximal lumen is used for sedation and amines such as norepinephrine and is usually used for blood extractions.[3]

The peripheral venous catheter is used to draw blood and administer treatments, such as intravenous fluids, medications, or blood transfusions.[4]

In neonates, it is common to use interposed filters in continuous intravenous perfusion equipment, whose objectives are: to eliminate inadvertent particles, reduce the risk of thrombophlebitis related to the infusion, reduce the risk of septic complications of intravenous treatment and reduce the risk of air embolism. [5]

Nutrition

Enteral nutrition is recommended when the patient's digestive system can fulfil its main function, the absorption of nutrients. In this case, a tube is placed through the nose into the stomach/intestine or the skin directly.[6]

Parenteral nutrition (PNT) consists of the administration of nutrients through a vein, to cover energy requirements when we do not have a functioning digestive tract or we cannot access the digestive tract. To manipulate the PNT, it must be done using a sterile technique and unnecessary manipulations must be avoided. The same PNT bag should not be connected to the patient for more than 24 hours.[7]

It is recommended to use infusion systems appropriate to the type of infusion pump used and opaque type to avoid peroxidation with exposure to light. In cases where lipids are administered separately from other nutrients, but through the same venous route, Y connectors are used. The use of filters is recommended in both pediatrics and adults since they retain the air, particles, and bacteria. 1.2 microns are used for lipid solutions and 0.22 microns in binary mixtures.[8]

Oxygen therapy

Once the need for oxygen therapy has been evaluated and indicated, the perfect balance must be achieved between patient comfort and effectiveness. The most used criterion to classify oxygen therapy systems is the flow of the gas mixture that reaches the individual: low or high flow.[9]

Nasal cannulas, simple masks, and reservoir masks are the most commonly used low-flow systems. Nasal cannulae are for patients with oxygen needs at low concentrations such as acute or chronic illness with hypoxemia and mild respiratory distress. Between 1-4 l/min should be supplied with oxygen fraction (FiO_2) levels of 24-36%. Simple masks are indicated for patients with acute or chronic lung disease with hypoxemia or mild to moderate respiratory distress. This device allows you to achieve an approximate FiO_2 of 40-60%, at a flow of 5-8 l/min. Reservoir masks are for patients with high-concentration oxygen needs such as severe respiratory failure or carbon monoxide poisoning, administration of anaesthetic gases, or after withdrawal of mechanical ventilation. High levels of FiO_2 can be achieved, 90-100%. The flow of oxygen supplied must be greater than 10-15 l/min to keep the reservoir constantly full and guarantee the delivery of oxygen in high concentrations.[9]

High-flow devices include the ventimask and high-flow nasal cannulas. The ventimask is indicated for patients with moderate hypoxemia with high and stable oxygen requirements. It reaches FiO_2 levels between 26-50%, corresponding to flows between 3-15 l/min. High-flow nasal cannulas are indicated for patients with high oxygen supply needs such as moderate respiratory failure, after removal of mechanical intubation, or discomfort with masks. They provide a constant FiO_2 and reaches FiO_2 levels greater than 50%.[9]

When there is an alteration in respiratory function, orotracheal intubation is necessary to provide an open airway. The material used for intubation is: a laryngoscope, endotracheal tube of various sizes, malleable metal guide, 10 ml syringe, stethoscope, oxygen intake, self-inflating bag, mask, an intravenous line placed and bandage to hold the tube.[10]

The most commonly used drugs in orotracheal intubation are sedatives, analgesics, opiates, and muscle relaxants. Sedation is indicated in all cases in which orotracheal intubation can be carried out, except in cases where the patient is in cardiorespiratory arrest or with a score on the Glasgow scale of 3 points. In most protocols, the most used drug is midazolam, a benzodiazepine with a hypnotic, anxiolytic, sedative, muscle relaxant, and anticonvulsant effect, which acts quickly on the central nervous system (CNS) but has a brief action.[10] Relaxation of skeletal muscle with an intravenous neuromuscular blocker facilitates intubation. Succinylcholine, a depolarizing neuromuscular blocker, has a rapid onset of action and short duration. Non-depolarizing alternative neuromuscular blockers such as rocuronium have a longer duration of action, but their onset is slower. These drugs produce complete muscle relaxation without effects on the CNS, therefore, the patient enters apnea while conscious. It is essential to have started anaesthetic induction and respiratory assistance.[11]

Inhalation sedation with halogenated gases constitutes an alternative route to the intravenous on in intensive care. Volatile anaesthetics at low concentrations can depress consciousness, maintaining autonomic functions such as thermal control, blood pressure, or breathing. Sevoflurane or isoflurane have poor solubility in blood, so the onset action and recovery are rapid. They have a hypnotic-sedative, bronchodilator, and barely analgesic effect. The AnaConDa© device is used for anaesthetic gases in the PICUs. This device is a heat and humidity exchanger filter that, inserted into the patient's ventilation circuit, allows the halogenated agent to be administered through a vaporization chamber connected to a syringe with a liquid anaesthetic. It is a small device, adaptable to all types of fans that allows the reuse of gas, with the consequent saving of anaesthesia. It is a single-use device, it must be changed every 24 hours.[12]

When caring for the intubated patient, the following aspects must be taken into account: the pressures in the cuff of the orotracheal tube must be kept below 25 cmH_2O to prevent necrosis of the tracheal mucosa due to compression, the adhesive tape must be alternated in each corner of the mouth; pharynx, and trachea requires frequent aspirations in intubated patients.[13] Aspirations of secretions must be carried out as sterile as possible; the probe must be introduced through the tube, without aspirating, until it stops and withdrawn 1 or 2cm. To aspirate the mouth or pharynx we will use large-caliber rigid or semi-rigid probes such as the Yankauer. The suction pressure must reach a maximum pressure of 300 mmHg with the tube occluded, it must be adjustable, and must not exceed 100 mmHg in children and intubated patients.

Tracheal suction time should be brief, between 5-10 seconds per aspiration to avoid hypoxemia and atelectasis.[13]

Inhaled nitric oxide is used as a selective pulmonary vasodilator that acts by reducing pulmonary arterial pressure and improving the ventilation-perfusion relationship. When inhaled, it diffuses from the alveolus to the vascular smooth muscle and in the bloodstream it is quickly inactivated, converting into methemoglobin and nitrates. For this reason, it does not produce systemic hypotension and limits the vasodilator effect to the pulmonary circulation.[14]

Evolution I.D.E.A.S.

The IDEAS information transfer model has 5 points, one for each letter of the name. A standardized model allows clear and precise messages to be transmitted about the specific situation, improving the efficiency and precision of communication. The use of this model creates security among professionals and reduces incidents related to patient safety. The I for identification of both the responsible professional and the patient: name and surname, sex, age, location, nationality, language, lifestyle... The D for both current and previous diagnoses. The E status takes into account: respiratory, hemodynamic, neurological, renal-metabolic, digestive-endocrine, locomotor-skin, and immunological-haematological pain function. The A of actions: respiratory support, drugs, routes, probes, techniques and instruments, diagnostic tests, and care. The S for warning signs and symptoms with the most important aspects that require special attention, including allergies.[15]

Hourly valuation

To assess the patient's condition, in addition to observation and physical examination, objective data related to a series of parameters must be measured, which constitute the so-called vital signs or signs: temperature, respiration, pulse, blood pressure, and central venous pressure. Today, pulse oximetry is considered by many to be another vital sign. In ICUs, most patients require that they be evaluated at least every hour.[16]

Diuresis is also controlled hourly. Oliguria is defined as urine output < 500 ml in 24 hours in an adult or < 0.5 ml/kg/h in an adult or child (< 1 ml/kg/h in neonates). The causes fall into 3 categories: prerenal related to blood flow, kidneys with intrinsic disease and post-renal conditions related to obstruction. In the case of oliguria, the identified causes are treated, the obstruction in the outflow tract is corrected, the volume is replaced and cardiac output is normalized.[17]

The drains allow us to know the amount of debit, and the volume that must be monitored. The Pleur-evac® is one of the most used in this type of unit, it consists of three chambers: the collection chamber, made up of three columns calibrated to control the volume evacuated, which allows controlling the volume, speed, and type of drainage. The hydraulic seal chamber consists of a reservoir for water, it is connected to the collection chamber and the suction control chamber. The aspiration control chamber is responsible for regulating the intensity of aspiration, the maximum in the pleural space is 15 mmH_2O.[18]

Patient care

The patient is cleaned and bed linen is changed daily. Patients in intensive care units have many risk factors for developing pressure ulcers (PU). The prevention of these is based on three main lines of action: risk assessment, general care, and pressure management. Nursing has an important role in preventing the use of mattresses with dynamic surfaces such as alternating air mattresses.[19] The administration of hyperoxygenated fatty acids at pressure points has demonstrated its effectiveness in increasing skin hydration against friction, pressure, and humidity, at the same time improving capillary circulation in ischemic areas, which is why they constitute an integral part of the treatment to prevent PUs in critically ill patients. They are administered every eight hours and during the patients hygiene it is administered.[20]

Another recommendation with strong evidence for protection against pressure is the use of non-adhesive polyurethane foam dressings in the shape of a heel, which allows daily inspection of the skin.[20] Regarding ocular hygiene, it is carried out every 8 hours with serum. Physiologically, epithelializing ointment is applied and if necessary the eyes are closed so that the dryness of the cornea does not increase, which could become complicated and produce ulceration.[21] Oral hygiene is also done every 8 hours with 0.2% chlorhexidine.[22]

Monitoring

Arterial catheterization for invasive blood pressure monitoring is a common technique in Critical Care Units both in the intra- and postoperative period. The data obtained on the monitor will reflect the patient's hemodynamic situation. The arterial translator must be in the phlebostatic axis, the reference point is the right atrium (RA). To eliminate the effects of atmospheric and hydrostatic pressure, a zero must be performed: the reference valve is closed to the patient and opened to the air, maintaining sterility intact. Initiate the monitor "zero" function and confirm that the pressure waveform and numerical value correspond to 0 mmHg. Once the zero has been observed, the valve is closed again and the cap is replaced. Finally, the system is flushed.[23]

Central venous pressure (CVP) monitoring is the intravascular pressure existing in the RA of the heart or the vena cava. It reports the preload or existing volume and is used to assess the functional status of the right heart, estimate volume to control fluid balance, and differentiate hypovolemic shock (low PVC) from obstructive or cardiogenic shock (high PVC). Normal values are 0 to 5 cm H2O in the right atrium and 6 to 12 cm H2O in the vena cava. Values below normal could indicate a decrease in blood volume and the need to administer fluids; while values above normal would indicate an increase in blood volume.[24]

Gasometry

Gasometry is a laboratory test in which the concentrations of gases in blood are detected. They can be arterial when the blood is extracted from an artery, usually done in the radial artery located in the wrist, or venous when the blood extracted is from a vein or a capillary.[25] To perform a capillary blood gas analysis, first we have to warm the heel for good vasodila-

tion and after disinfecting the area, apply Vaseline, this promotes the formation of blood drops, preventing it from spreading through the skin, it is punctured with a lancet, the first drop of blood is discarded and the capillary tube at an angle of 15 to 30º to prevent air bubbles from entering.[26]

It not only allows us to know if there is a normal amount of oxygen and carbon dioxide but also if there is an imbalance in the amount of acid and base that the body naturally has, which can be altered in respiratory or endocrine diseases, such as diabetes.[25]

Neurology

To assess the neurological status, consciousness is evaluated (alert, obtundation or lethargy, stupor, coma...) and the Glasgow scale is performed. In addition, the pupils are examined, the normal diameter is 2 to 3 mm, a diameter less than 3 mm is miosis and greater than 5 mm is mydriasis.[27]

Equality in the size of the pupils is called isochoric and inequality anisocoria. Within anisocoria, we find miosis, the contraction of the pupil generated by a variety of conditions, including certain drugs or chemicals such as opioids. Mydriasis, on the other hand, is an increase or dilation of the pupil, which may be due to: cerebral anoxia, severe hypotension, hypothermia, barbiturate coma, withdrawal of opiates, etc.[27]

To assess your reaction to light, your pupils must be tested for direct response to light. Normally, the pupil contracts when faced with a light stimulus and remains contracted for as long as the light stimulus is maintained. It will be recorded if the reaction has been fast, slow, or absent. The lack of pupillary reactivity may be due to hypothermia, barbiturate coma, or recent CRP.[27]

PICU FOR BEGINNERS

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Nursing skills to survive in pediatric intensive care units

CARDIAC ARREST

Hospital

Monitoring and prevention → Recognition and activation of the emergency response system → Immediate quality CPR → Rapid defibrillation → Advanced life support and post-cardiac arrest care

!!! 5 rescue ventilations
We value if there are no signs of life or pulse <60 bpm
We start compressions 15/2

!!! DEA
>8 years: adult patches
1-8 years: pediatric patches (load 50-75 J)
Infants: AED with attenuators

Medication

- **Physiological saline** (NaCl 0,9%) 10cc
- **Adrenaline 1 ampoule** (1mg/ml) + 9 cc H2O -> 0,1 mg/ml
- **Atropine 1 ampoule** (1mg/ml) + 9 cc H2O -> 0,1 mg/ml
- **Sodium bicarbonate** (1M) 5ml NaHCO3 + 5cc de H2O -> 1 mEq en 2ml
- **Calcium chloride 10%** (CaCl2 1 mEq/ml), pure -> 100mg/ml

NUTRITION

Enteral
Absolute: extubate/intubate, sedation, intervention...
Parenteral: sterile + change of the entire system every 24 hours
Lipids Opaque systems

EVOLUTION I.D.E.A.S

IDENTIFICATION
DIAGNOSIS
STATUS ACTION
ALARM
SIGNS AND SYMPTOMS

ADMINISTRATION ROUTES

Central venous cannulation

Distal
High flow or density fluids + medication

Proximal
Sedoanalgesia and amines such as norepinephrine

Once the drugs are removed, the line is flushed with SF at the same ml/h, long enough to clean the catheter.

Peripheral venous cannulation
Extract or transfuse blood, administer treatments...

In neonates, it is common to use 1.2 micron filters if they receive a ternary mixture, otherwise 0.22 micron filters will be used.

SHIFT

Hygiene

- Corpitol (hyperoxygenated acids) + PU Allevyn™
- Eye wash with NS + epithelializing ointment.
- Oral hygiene with 0.2% chlorhexidine

Every hour

Vital signs: RR, HR, BP, SPO2, CVP, T°
Diuresis: 0.5 ml/kg/h -> minimum
Drains: Pleur-evac
1st collection chamber — Control vol. evacuated
2nd hydraulic seal chamber — -high pressure valve -iva, +iva pressure relief valve
3rd aspiration control chamber — Regulates the suction intensity, max 15 mmH2O

OXYGEN THERAPY

Intubation equipment
Laryngoscope
Endotracheal tube
Malleable metal guide
10ml syringe
Stethoscope
oxygen intake
Ambu and mask
Channeled intravenous line
Bandage to hold the tube

Low-flow

- Nasal glasses
- Simple mask
- Mask with reservoir

High-flow

- Ventimask Mask
- High flow nasal cannulas

Size of orotracheal tubes according to age
New born - 4 months: 3 mm
4 months- 5 years: 4-5 mm
6 - 9 years: 6-7mm
Female: 7.5-8.5mm
Male: 8-9 mm

Secretion aspiration - endotracheal tube

- **Aspirate mouth** - large caliber rigid or semi-rigid probes **Yankauer** probes
- **Suction pressure** - 100 mmHg in children
- **Suction time** - 5-10 sec.
- Insert the probe, without aspirating, until it stops and remove 1 or 2 cm
- Sterile technique
- The cuff pressure at 25 - 30 cmH2O

MONITOR

CVP

Increased volemia → +
Normal values:
- **0-5 cm H2O in the right atrium**

\- → Volemia decrease + fluid need

INVASIVE BP MONITORING
The phlebostatic axis: the right atrium.

Make a 0:
Close the reference cock to the patient and open to air
Start the monitor "zero" function
"zero" is observed on the monitor
Close the key again
Flush the system.

NEUROLOGY

Sedative-hypnotic drugs can significantly attenuate the pupillary light reflex

Pupils

- **reactive or unreactive**
- **Intermediate** — miosis, mydriasis, pinpoint
- **Isochoric or anisochoric (D<I), (D>I)**

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