Editorial

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Bronchoscopy in the ICU. Simple procedures in difficult cases

Broncoscopia en la UCI. Procedimientos simples en casos complejos

Broncoscopia na UTI. Procedimentos simples em casos complexos

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Critical Care Medicine is characterized by the agile incorporation into the clinic of all technological advances in the area of monitoring and diagnosis, as well as the dynamic adoption of therapeutic innovations and life support for the benefit of critically ill patients. The specialty has significantly increased its complexity, being currently a multidisciplinary and transdisciplinary discipline with multiple connections with almost all areas of medicine.

Thus, the intensive care physician has been covering skills and abilities that at one time were the exclusive competence of other specialists. One of these clinical competencies is bronchoscopy, which in our national background has always been considered within the UNAM Unique Program of Medical Specialties (PUEM) for the training of medical specialists in Critical Care Medicine.[1] In CoBaTriCE (Competency-Based Training in Intensive Care Medicine in Europe), supervised fiberoptic bronchoscopy in the intubated patient, performing bronchoalveolar lavage (BAL), and performing a supervised percutaneous tracheostomy are also considered within the respiratory domain[2] *(Table 1)*.

There are several medical specialties that share this competence, of course pulmonary medicine (closely linked to Critical Medicine) in the first place, followed by Thoracic Surgery, Critical Medicine and Anesthesiology.

Advanced bronchoscopic techniques belong exclusively to the specialist in lung diseases (transbronchial biopsies, EBUS, guide sheath devices for peripheral lesions, thermoplasty, debulking, balloon dilation, stent placement, foreign body removal, etcetera), and bronchoscopic interventions in Anesthesiology and Thoracic Surgery are basically confined to the operating room in selected cases.

There are, however, many other bronchoscopic indications in critically ill patients that the intensive care physician must be aware of and be in a position to address urgently in any ICU.

These include between those of a therapeutic type, the resolution of large atelectasis in the hypoxemic patient, bronchoscopic intubation in difficult airways, and carrying out percutaneous tracheostomy; and between the diagnostic indications, the performing of a BAL in the frequent pneumonia scenery and other conditions that simulate it in the ICU, such as alveolar hemorrhage, as well as the evaluation of the burned airway and the positioning of double-lumen endotracheal tubes in differential ventilation, among others.

The interesting part of the bronchoscopic procedure in the critically ill patient, and that makes it a challenge, is not the procedure per se, which as already mentioned, will be in general quite simple, but the complexity of the case in which this study will be carried out;[3] an intubated critically ill patient under mechanical ventilation with PEEP, with an increased risk of hemodynamic instability and bleeding, air trapping or pneumothorax, so attention to detail is paramount. The procedure is not as simple as inserting the instrument and aspirating anywhere, and the study must always be supervised in person by an expert, ideally a specialist in Pneumology, especially high-risk ICU patients such as those labile to hypoxemia, unstable coronary patients or uncontrolled asthmatics.

The medical team must have full knowledge of the pathophysiological changes that a bronchoscopy can induce in an intubated patient under mechanical ventilation (effects on lung mechanics, airway resistance, functional residual capacity, peak inspiratory pressure and PEEP increase, loss of delivered Vt, decrease in dynamic and static lung compliance, the effects on gas exchange with an increased Qs/Qt secondary to surfactant washout and alveolar collapse as well as the cardiovascular effects).[4]

The starting point is to have a robust indication and no contraindications, as well as to prepare everything necessary in advance with a clear idea of what should be done.

It should start with having trained personnel, being comfortable, with appropriate lighting conditions and having a good wall suction is basic. Trimming the endotracheal tube a few centimeters will allow better manipulation of the instrument, which must be known

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Table 1: CoBaTriCE respiratory domain bronchoscopy competence description, including knowledge, skills and behaviours and attitudes.[1]

Performs fibreopric bronchoscopy and BAL in the intubated patient under supervision
Knowledge
Signs, symptoms and causes of acute airway insufficiency and indications for intervention
Principles of emergency airway management
Anatomy and bronchoscopic appearance of the upper and lower airways
Patient selection-indications, contraindications and potential complications of the procedure/intervention
Appropriate use of drugs to facilitate airway control
Principles of aseptic technique and aseptic handling of invasive medical devices
Universal precautions and preventative infection control techniques (hand washing, gloves, protective clothing, sharps disposal etc.)
Complications of the technique, how to prevent/recognise them and initiate appropriate treatment
Detection of potential physiological alterations during the procedure
Indications for specific monitoring to ensure patient safety during an intervention/procedure
Methods of bronchoscopy via an endotracheal tube
Methods of bronchoscopic broncho-alveolar lavage (BAL) in an intubated patient
Detection and management of haemo/pneumothorax (simple and tension)
Safety and maintenance of flexible fibreoptic endoscopes
Skills & behaviours
Seek appropriate supervision-discuss the patient and procedure with supervisor prior to undertaking it
Identify relevant anatomical landmarks
Prepare equipment, patient and staff prior to undertaking the procedure
Choose an appropriate route/method of insertion and position the patient accordingly
Obtain informed consent/assent from the patient where appropriate
Undertake bronchoscopy to assess tube position
Undertake bronchoscopy to perform bronchoalveolar lavage
Performs the procedure in an aseptic manner (scrubs, gowns, gloves, drapes & sterile field)
Perform the procedure in a manner which minimises the risks of complications
Sterilise, clean or dispose of equipment appropriately
Recognise and manage emergencies; seek assistance appropriately
Attitudes
Recognises personal limitations, seeks and accepts assistance or supervision (knows how, when and who to ask)
Considers patient comfort during procedures/investigations
Desire to minimise patient distress
Accepts personal responsibility for the prevention of cross infection and self infection
Lead, delegate and supervise others appropriately according to experience and role
Supports other staff in the correct use of devices
Promotes respect for patient privacy, dignity and confidentiality

perfectly by the operator. In order to be able to work with the bronchoscope on an intubated patient and at the same time be able to ventilate him without inducing uncontrolled air entrapment, an endotracheal tube or tracheostomy cannula of good caliber must be available. It is not uncommon to have to change the endotracheal tube for one of a larger caliber prior to the study, either in the usual way with the laryngoscope or with the new cannula mounted on the bronchoscope. A size 8 or larger orotracheal tube is required to perform therapeutic bronchoscopy in adults (with a bronchoscope 5.7 mm), although this correlates with the patient's body mass and the caliber of the instrument used and is subject to a wide variability, it is therefore generally recommended that the internal diameter of the orotracheal tube be > 2 mm greater than the external diameter of the bronchoscope.

If it is possible to select between various equipments, the one with the largest working channel must be chosen for ICU therapeutic bronchoscopy. Here begin a series of details that should not be overlooked. The first is to seek the best possible help, with the best trained staff, both nursing and respiratory therapy, the procedure should be as clean as possible, taking care of all the sterility details. An Anesthesiologist or a Critical Care Medicine resident should be in charge of monitoring the patient's sedation and tolerance, monitoring the patient and ensuring that everything runs smoothly.

Positioning of the patient should be appropriate, bringing his or her head closer to the headbord for comfortable posterior access in a standard technique. In special cases, the procedure can be carried out with an anterior approach in patients in Fowler and very occasionally even in the prone position; it will always be necessary to seek the greatest possible comfort for the operator.

Check and recheck the orotracheal tube caliber as well as the proper functioning of the wall suction and depending on the characteristics of the case and what is planned to be carried out, select in advance the level of negative pressure that will be required during the study, it is not the same to unclog an obstructed bronchus due to a thick plug of mucus than to perform a BAL in a case where it is desired to explore the cell population, such as when an acute eosinophilic pneumonia is suspected.

Check the patient at least 20 to 30 minutes before the procedure and while you consider the details with the nurse and the respiratory therapist, and check that the informed consents are completely filled out and signed by the patient's legal guardian, and while making sure you have everything you need including full monitoring and a full CPR cart, review the parameters of the mechanical ventilator and the gas exchange achieved with them, review significant lab results, observe the blood pressure and its trend and the drugs being infused. Check other vital signs and make sure the patient is afebrile. Observe the electrocardiographic tracing and its trend.

The first modification that should be made to the ventilator is to increase the FiO_2 to 100% and observe the response on the pulse oximetry, which should ideally reach 100%. Once this is achieved, the PEEP level will be slowly and gradually decreased.

In general, the PEEP level should be set if possible below 5 cmH_2O before starting the procedure and in patients with a high basal PEEP level, it should be reduced by at least 50%, taking into account the induction of air entrapment when having the instrument inside the airway, which will generate auto-PEEP, which can be directly measured by connecting the bronchoscope to a pressure transducer. There are different ventilatory maneuvers to reduce air trapping; always closely follow the oxygenation, and if it is possible temporarily to take the patient to ZEEP (zero PEEP) do it.

Before introducing the bronchoscope, ensure the safety conditions of your most precious resource, health personnel, the correct functioning of the swivel adaptor, the SpO_2 and baseline vital signs and in cases of starting with PEEP levels higher than 5 cmH_2O, clamp the orotracheal tube to avoid sudden alveolar derecruitment and the generation of potentially dangerous aerosols.[3]

Even in sedated and relaxed patients, it is customary to protect the investment in the bronchoscopy equipment by placing the bite blocker.

One of the most important pre, trans and postbronchoscopy interventions is the correct management of the mechanical ventilator, so in addition to respiratory and hemodynamic monitoring it is essential to have good second hands and a third eye.

It has been discussed which is the best ventilatory mode to carry it out, volume controlled (VCV) (which I personally prefer with the appropriate safety locks by selecting the pressure alarm levels) or pressure controlled (PCV) (where it will be necessary to watch for alveolar hypoventilation). I believe that the selection should be based on the one that the attending physician knows and understands best, although we know that with either of the two modes of ventilation, the Vt delivered will decrease in relation to a smaller cross-sectional area of the orotracheal tube to the extent that there is less lung compliance regardless of the mechanical respiratory rate, being this effect less in PCV at low ventilatory rates, although progressively lost as it increases and totally canceled when using small-caliber endotracheal tubes (7.5 mm), however, perhaps the most interesting thing is that less air entrapment is induced with this last mode. In either case, it will be necessary to adjust the mechanical ventilatory frequency and the inspiratory peak flow (the ratio of inspiratory to expiratory times) and use a descending waveform and the largest caliber of orotracheal tube possible, accepting the fact that the pressure limit will be momentarily outside the alveolar protection goals, where the skill and mastery of the operator can make a big difference.

Certainly alternative methods of mechanical ventilation or novel modes of ventilation with which the medical team does not have sufficient experience are not ideal for carrying out a bronchoscopic procedure safely.

We know that activating the suction during the procedure aspirates tidal air, not just mucus and phlegm, so this resource must be used judiciously. Even if this is done, in some way we will sacrifice some effective alveolar ventilation during the bronchoscopic approach, so it is recommended to increase temporarily the mechanical Vt a little before starting, approximately 100 to 200 mL (more or less 30% of the preselected basal mechanical Vt), always monitoring how the dependent variables of such maneuver are affected, although each case is different depending on its particular dynamic elastic characteristics.

Clinically significant hypoxemia may develop with some frequency, making it imperative to stop the bronchoscopy for a few minutes; during these waiting periods and while the instrument is kept out of the airway, it will be important to keep an eye on the mechanical ventilator monitoring and make any necessary adjustments.

The period of risk for the patient is not limited to the exact moment of the bronchoscopy, but can extend beyond time, mainly gas exchange and compliance alterations, so the period of close monitoring should cover a period long enough to ensure patient stability, without overlooking the recovery of the PEEP level that the patient had before the procedure.

Those responsible for postgraduate medical education in Critical Care Medicine should teach and supervise all of these aspects; the specialist in this area of medicine must have a solid preparation in all aspects given the complexity of critical patient care, where the margin of error is very short, but the benefit of a timely indicated procedure and skilfully carried out is maximum with minimal complications.

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