Bronchofibroscopy in the intensive care unit: experience at the Hospital Garcia de Orta

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Abstract

The author reports his experience in fibreoptic bronchoscopy in critically ill patients in intensive care units. 113 patients underwent bronchofiberscopic examinations over a 14-month period, 94 of whom received mechanical respiratory support. He points out the more important endoscopic views and defines some rules for performing the examination with relative ease.

Key words: flexible fiberoptic bronchoscope; fiberoptic bronchoscopy; intensive care unit; hypoxemia.

Introduction

The bronchofibrescope, introduced by Ikeda in 1968, revolutionized bronchial endoscopy theretofore practiced with rigid bronchoscope. The refinement both of the actual apparatus and its accessories increased the chances of visualizing the tracheobronchial tree and the capacity to obtain specimens. As the technology evolved, our understanding of the applications and limits of the technique also increased. One of the fields in which bronchofibroscopy proved inestimable, now constituting an essential and routine exam, is the ICU patient. The high safety of bronchofibroscopy enables it to be used in critically ill patients, particularly those under ventilation[1].

There are several indications for carrying out bronchofibroscopy in the ICU (*Table 1*), the most frequent of which are as follows[2]:

- Removal of secretions
- Resolution of atelectases
- Evaluation and control of hemoptyses

The aim of this study is to conduct a review of the bronchofibroscopy examinations carried out on patients in the ICU and similar units of the Hospital Garcia de Orta, and to suggest some rules that will facilitate the execution of the technique and reduce its risks.

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Material and methods

In the 14-month period of the study (January 1993 - February 1994), 113 bronchofibroscopies were performed in the ICU, IDCU (Immediate Differentiated Care Unit), UCD (Differentiated Care Unit) and recovery wing of the Block (88H; 25M). Patient's ages ranged from 15 to 83 years. 94 patients were ventilated (13 tracheostomized), 16 were intubated (not ventilated) and 3 were breathing spontaneously.

The indications for performing the exam were varied (*Table 2*), as were the endoscopic aspects (*Tables 2 and 3*).

A 4.9 mm fibroscope was used as standard. In specific cases, we used other types of fibroscope (measuring 6 mm in 26 cases and 3.5 mm in 8 cases). The cold light source was conventional (halogen bulb), compact and portable.

Before the start of the exam, in the ventilated patients, the F102 of the ventilator was set at 100% and maintained throughout the procedure. The minute volume was also increased by 50% in relation to its current value, and if there was PEEP, this was disconnected. This was followed by anesthetization of the tracheobronchial tree with lidocaine, which was injected directly through the endotracheal tube. The bronchofibrescope was then introduced into the tracheal tube through a Swivel, specially designed for this purpose, which serves as connection between the ventilator trachea and the tracheal tube. On introduction the cuff was exsufflated. A mouthpiece was used in all cases where the patient was orotracheally intubated. The endoscopy nurse, besides assisting in the exam, was also responsible for fixing the mouthpiece between the patient's teeth. Another member of

TABLE I

Indications for bronchofibroscopy in an ICU

Diagnostic
Hemoptyses
Pneumonia (infectious and aspiration)
Thoracic trauma
Inhalation of toxic substances
Acute obstruction of the airways
Control of the endotracheal tube
Therapeutic
Aspiration of secretions
Atelectases
Removal of foreign bodies
Complicated intubations

TABLE II

Indications for bronchofibroscopy in this study

Atelectases	79
Infectious pneumonia	12
Hemoptyses	7
Thoracic trauma	3
Vasculitis	2
Aspiration pneumonia	2
Tumor	2
Pleural effusion	2
Esophageal rupture	1
Pneumonia + esophageal tumor	1
Difficulty in intubation	1
ARDS	1

staff supervised the patient's clinical state (cyanosis; agitation and dyspnea) as well as the various support systems (ventilator; oximeter and cardiac monitor).

The exam had to be performed quickly, taking special care in the observation of the trachea (we habitually removed the endotracheal tube a few centimeters in order to inspect the main portion of the trachea). The suction used was gentle, discontinuous and for the shortest period of time deemed necessary. For the bronchial washing and the bronchoalveolar lavage (BAL) we used saline solution, at a volume strictly necessary and at room temperature. As complementary exams to the abovementioned bronchoalveolar lavage, we performed bronchial biopsies and used a doubly protected telescopic catheter. No transbronchial lung biopsy (TLB) was performed.[1] The tube position was verified on removal of the apparatus, and at the end of the exam we insufflated the cuff and reset the initial parameters of the ventilator (except for the FiO2) which remained at 100% for at least 5 min. We do not request chest X-rays for control purposes on a routine basis. In the case of atelectasis, the chest X-ray was repeated after 4 hrs.

Results

In the tracheotomized patients, there was no difficulty intubating the patients (for those intubated with an endotracheal tube) and the largest caliber bronchofibrescope (6 mm) was used almost systematically.

In two cases, it was necessary to resort to the bronchofibrescope in order to perform urgent intubation, as this maneuver had proven impossible by the conventional method.

In one of the patients with hemoptyses the bronchofibroscopy revealed an almost total obstruction of the trachea and of both mainstem bronchi by voluminous clots.

This was a case of intense hemorrhage and the bronchofibrescope proved insufficient to clear the airways. This patient underwent urgent rigid bronchoscopy three times, this method proving totally effective in terms of bronchoaspiration.

In another patient with hemoptyses, the bronchofibroscopy revealed a voluminous clot that was impossible to aspirate using the bronchofibrescope. Citrate was then injected into the clot, but the results were barely evident in terms of its resolution.

Only one bronchial biopsy was performed in a case classified as "pneumonia". The histological result was "organizing pneumonia".

Secretions were sent for analysis in only three patients, whose results were as follows:

- Lowenstein positive – 1;
- BAAR positive – 1;
- Pseudomonas – 1.

BAL's were performed on two patients with suspected *P. Carinii* pneumonia, proving positive for that microorganism.

The doubly protected catheter was used in another case in which BAL was performed, but the laboratory did not provide results.

In one patient in whom ventilation proved difficult, there was suspected poor positioning of the ET tube. The bronchofibroscopy revealed an accentuated respiratory collapse of the trachea.

TABLE III

Endoscopic aspects

Secretions (purulent; viscose; plugs; molded; inspissated)	66
Inflammation (edema; secretions; hyperemia; whitened plaques)	28
Blood (clots; hemorrhagic spotting; severe hemorrhage	8
Ulcer of the anterior tracheal wall	5
Extrinsic compression (effusion)	2
Granuloma	1
Hyperemia	1
Surgical scar	1
Tumor	1

TABLE IV

Complications of bronchofibroscopy

Pre-medication
Respiratory depression
Hypotension or syncope
Hyperexcitation

Local anesthesia
Laryngospasm
Bronchospasm
Convulsions
Cardiorespiratory failure

Bronchoscopy
Bronchospasm
Laryngospasm
Hypoxemia
Arrhythmias
Fever
Pneumonia

Procedures (biopsy/brushing)
Pneumothorax
Hemorrhage
Pneumonia

Complications

There were several situations in which cyanosis emerged during the exam, necessitating temporary suspension of the procedure. This was subsequently completed.

Only one bronchofibroscopy was left uncompleted due to extreme bradicardia of the patient. In another case, severe damage was caused to the bronchofiberscope (teeth marks).

There was no record of other types of complications.

Comments

Hypoxemia as a consequence of bronchofibroscopy is a well-established situation,[3] caused by a drop in PaO2, which can reach 20 mmHg and last up to 4hrs after the exam.

A drop in PaO2 was consistently described in the ventilated patients[2], reaching 26% at the end of the bronchofibroscopy. The causes indicated were severity of the lung situation (and respective decrease in alveolar ventilation), the patient's "struggle" against the ventilator, and suction. The latter[4] contributed to the hypoxemia, not only because it removes part of the current volume provided by the ventilator, but also because it causes alterations in V/Q ratio.[5]

The bronchial wash[6] frequently practiced in ICU's is also a cause of hypoxemia, which results from alteration in V/Q, as the alveoli full of liquid continue to be perfused, giving rise to an increase in intrapulmonary shunt.

Other physiological alterations caused by bronchofibroscopy are of a hemodynamic nature[5] (increases in AT, the CF, cardiac index, and mean pulmonary artery occlusion pressure).

These variations are caused by a reflex sympathetic discharge caused by the movements of the bronchofibrescope inside the bronchi, by mechanically irritating their walls. This contact with the walls of the bronchi is also accountable for the appearance of bronchoconstriction phenomena.

Patients admitted to the ICU usually present severe clinical situations[7] (heart disease, COPD, pneumonia and tumor). They are instable patients and hypoxemia (8 and 9) by atelectasis, alteration in V/Q, shunt or occlusion of a main bronchus is frequent. These patients have limited cardiorespiratory reserves and therefore the effects of bronchofibroscopy on the cardiopulmonary function, although minimal, can have major repercussions.

Hypoxemia predisposes to cardiac arrhythmias, and blood pressure and heart rate increases during bronchofibroscopy can provoke cardiac ischemia[9] and cardiac arrest[7].

The intrinsic complications of bronchofibroscopy[10] (chart 4) can take on more important proportions in this type of patient.

Thus, it is understood that one of the problems

faced by endoscopists when performing bronchofibroscopy on a ventilated patient is the maintenance of oxygenation during the exam.

To avoid this situation, Trouillet and Col. [2] suggest the induction of complete sedation, the use of local anesthetics, and endoscopy at high FiO2 levels.

Although with totally different characteristics, another problem that endoscopists have to overcome is related to the movements of the tracheobronchial tree. When submitted to a flow under positive pressure, this appears highly dynamic, hindering not only the orientation and the identification of the intrabronchial structures, but also the control of the bronchofibrescope.

As in the other studies,[2] atelectasis was the main indication for fibroscopy. In these cases the endoscopic appearance is very distinctive and corresponds to what is commonly described as "acute bronchitis" or "inflammation" of the tracheobronchial tree (*Table 3*).

1 – Mucosal edema: this can reach high levels, and may be diffused. In the case of spurs, their widening can completely occlude or reduce the narrow gap; the segmental lumen.

2 – Secretions – Normally abundant and purulent, they can be extremely viscous, difficult to aspirate, and appear in the form of plugs.

3 – Hyperemia – Marked and diffuse. There can be zones with erosion of the mucosa.

4 – Plaques – White in color. They can correspond to necrotic zones (this finding is inconstant, but characteristic).

These alterations have benign evolution and *restitutio ad integrum* appears with the improvement of the clinical situation.

Conclusion

Bronchofibroscopy in patients undergoing intensive care is a delicate and potentially risky exam. However, its usefulness is undeniable.

To maximize its cost effectiveness and minimize its morbidity, we suggest the following rules:

1 – Indication for performing bronchofibroscopy: The analysis of the request to perform the bronchofibroscopy should be stringent.

2 – Operator: In this particular case the bronchofiberscope operator should be extremely fast in executing the exam. We recommend that this type of bronchofibroscopy be executed only by an experienced technician, with training in intensive care if possible.

3 – Endoscopy nurse: It is essential that the operator be assisted by a nurse trained in bronchial endoscopy, and who should be attentive at all times, to any complications that might arise.

4 – Bronchofiberscope: We suggest the use of a 4.9 mm apparatus, as this diameter allows passage in most E.T. tubes, while allowing all the accessory maneuvers (aspiration, biopsy and lavage) to be performed.

5 – Swivel: also commonly called a "T-tube", this is an essential item for preserving the Vt provided by the ventilator.

6 – Ventilator: Increase the min./vol. by 50% at the beginning of the exam[11]. Set the FiO2 to 100% at the beginning of the exam and up to 5 min. after its conclusion.

Unlike Rezende[7] we do not consider the times indicated by that author (20 min. before and after the exam) necessary. Disconnect the PEEP.

7 – Endotracheal tube: Deinsufflate the cuff during the exam to avoid the risk of barotraumas.

Always use the mouthpiece when the patient is intubated orotracheally. In this case the action of the endoscopy nurse in fixing the mouthpiece throughout the exam is essential;

The ET tube provides an advantage[12] as it allows the quick introduction and removal of the *bronchofiberscope* (cleaning of the lenses and biopsies).

8 – Exams: Visualize the largest possible portion of the trachea. If necessary, withdraw the E.T. tube a few centimeters. Special attention should be paid to the cuff zone and to the distal extremity of the tube (occurrences of tracheal ulcers).

Interrupt the exam if there are complications, namely arrhythmias, bradicardia or cyanosis.

Use a low, intermittent suction level. Use a small volume of saline solution either for the bronchial wash or for the BAL. Rezende[11] recommend a solution at 37ºC. We do not consider this measure necessary as we did not have any complication attributed to the temperature of the saline solution. Do not perform TBPB on a ventilated patient.[1,10]

9 - Monitoring: Carry out the exam under cardiac monitoring and connected to an oximeter.

10 – Chest x-ray: We do not perform a chest x-ray routinely after the exam. Contrary Rezende[11], Milam et col[13] affirm that X-ray immediately after fibroscopy rarely provides useful clinical information or detects a

complication that is not clinically suspected. The reason for requesting X-rays after fibroscopy is justified when performing TBPB (risk of pneumothorax), an exam that was not performed in this study. ■

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