Accidental fracture of the tip of the Coopdech bronchial blocker during insertion for one lung ventilation

Bris accidentel de l'extrémité d'un bloqueur bronchique Coopdech pendant son insertion lors d'une ventilation sélective

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Abstract

Purpose The distal tip of a Coopdech bronchial blocker has a preformed angulation to aid placement in the desired bronchus. We report two cases wherein this design may have resulted in distal tip fracture due to entanglement at the level of the Murphy's eye of the endotracheal tube or at the carina.

Clinical features A 49-yr-old female had a Coopdech bronchial blocker inserted into her right main bronchus for video-assisted thoracoscopic (VAT) lung biopsy. Resistance was encountered on its insertion, followed by confirmation of its position by fiberoptic bronchoscopy. As lung isolation was inadequate, bronchoscopy was repeated during surgery. This showed fracture of the blocker tip that required patient repositioning and insertion of another blocker. In a second incident, a bronchial blocker was inserted into the right main bronchus of a 19-yr-old male for VAT bullectomy. This procedure was performed under continuous fiberoptic guidance. Nevertheless, it was difficult to pass the blocker tip beyond the Murphy's eye of the endotracheal tube, as repeated attempts resulted in its entanglement and fracture. Another blocker was inserted by maneuvering the tip beyond the Murphy's eye.

Conclusion The preformed tip of the Coopdech bronchial blocker can be damaged at the Murphy's eye of the endotracheal tube or at the carina. This can result in tip fracture, especially during insertion into the right main

bronchus. Maneuvering the tip away from the Murphy's eye can circumvent this problem. Continuous bronchoscopic guidance should be used as recommended by the manufacturer.

Résumé

Objectif L'angle de l'extrémité distale du bloqueur bronchique Coopdech est préformé de façon à faciliter son positionnement dans la bronche désirée. Nous rapportons deux cas dans lesquels cette forme a eu pour résultat un bris de l'extrémité distale en raison d'un enchevêtrement au niveau de l'œil de Murphy de la sonde endotrachéale ou à la carène.

Éléments cliniques On a inséré un bloqueur bronchique de Coopdech dans la bronche souche droite d'une femme de 49 ans afin de réaliser une biopsie thoracoscopique vidéo-assistée. Une résistance a été ressentie pendant l'insertion du bloqueur, suivie par la confirmation de sa position par bronchoscopie par fibres optiques. L'isolement pulmonaire étant inadapté, la bronchoscopie a été réitérée pendant la chirurgie, et a révélé un bris de l'extrémité du bloqueur, ce qui a nécessité un repositionnement de la patiente et l'insertion d'un autre bloqueur. Dans un deuxième incident, un bloqueur bronchique a été inséré dans la bronche souche droite d'un homme de 19 ans pour une bullectomie par thoracoscopie vidéo-assistée. Cette procédure a été réalisée sous repérage constant par fibroscopie. Cependant, il a été difficile de passer l'extrémité du bloqueur au-delà de l'œil de Murphy de la sonde endotrachéale, étant donné que les tentatives répétées ont eu pour résultat son enchevêtrement et son bris. Un autre bloqueur a donc été inséré en guidant l'extrémité au-delà de l'œil de Murphy.

Conclusion L'extrémité préformée du bloqueur bronchique Coopdech peut être endommagée au niveau de

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l'œil de Murphy de la sonde endotrachéale ou de la carène. Ceci peut provoquer un bris de l'extrémité, particulièrement pendant son insertion dans la bronche souche droite. Pour éviter ce problème, il peut être utile de guider l'extrémité du bloqueur en l'éloignant de l'œil de Murphy. Un repérage constant par bronchoscopie devrait être utilisé, comme le recommande le fabricant.

Various anesthetic techniques and equipment have been described for lung separation and one-lung ventilation (OLV) during video-assisted thoracoscopic surgery (VATS). Broadly speaking, techniques involve insertion of either a double-lumen tube (DLT) or a bronchial blocker. Except in a few circumstances, this choice is mostly a matter of preference.¹⁻³ Many devices have been manufactured and developed for use in lung separation during thoracic surgery. The following bronchial blocking devices are commonly in use: the wire-guided Arndt blocker (Cook Critical Care, Bloomington, IN, USA), the Cohen blocker (Cook Critical Care, Bloomington, IN, USA), the Univent blocker (Fuji Systems Corporation, Tokyo, Japan), the Fuji blocker (Fuji Systems Corporation, Tokyo, Japan), and the Fogarty embolectomy catheter (Edwards Lifesciences LLC, Irvine, CA, USA). The distal tip of the recently introduced Coopdech bronchial blocker (Daiken Medical Co. Ltd, Osaka, Japan) has a preformed angulation that is similar to the Fuji blocker (Figure 1) and designed to facilitate easy insertion and positioning in the desired main bronchus. We report two cases of accidental fracture of the tip of the Coopdech endobronchial blocker during insertion and discuss the potential reasons for these catheter fractures. Both patients gave written informed consent for publication of this article.

Case reports

Case 1

A 49-yr-old female presented for VATS and lung biopsy for suspected metastatic pulmonary nodules in her right lung. Previously, she had undergone abdominal hysterectomy for uterine sarcoma, and pulmonary nodules were noted on follow up. Her medical history was unremarkable except for mild asthma. No abnormality of her trachea or major bronchi showed on her chest x-ray.

Following induction of anesthesia, her trachea was intubated uneventfully with an 8.0 mm internal diameter (ID) tracheal tube cut at 26 cm. After securing the tube, the bronchial blocker (Coopdech) was inserted through the tracheal tube. Resistance was encountered before the 30 cm mark at the connector level, and the blocker was

Fig. 1 Normal Coopdech bronchial blocker showing the preformed angulation

withdrawn and reinserted beyond the 30 cm mark prior to bronchoscopic review. Fibreoptic bronchoscopy confirmed the position of the bronchial blocker in the right main bronchus. The cuff of the bronchial blocker was inflated with 5 mL of air to facilitate OLV. Subsequently, the patient was placed in a left lateral position, and the position of the bronchial blocker was reconfirmed by bronchoscopy prior to skin incision. During thoracoscopy, the right lung was found to be partially inflated with each inspiration, and no improvement was produced with further inflation of the bronchial blocker.

Displacement of the bronchial blocker was suspected, and further bronchoscopy was performed to enable repositioning. However, when the cuff was deflated, the tip of the catheter was seen facing the bronchoscope. A diagnosis of tip fracture was made, and it was decided to replace the blocker. Subsequent attempts to withdraw the blocker failed because the bent tip hooked the tracheal tube making it impossible to withdraw the blocker without extubation of the trachea (Figures 2, 3).

The surgery was stopped and the patient was turned supine while the tracheal tube was removed together with the bronchial blocker. Then the trachea was re-intubated and the lung was isolated under bronchoscopic guidance with another Coopdech bronchial blocker from a different batch. No trauma or bleeding in the trachea or major bronchi was revealed with bronchoscopy. The surgery was performed successfully, and the patient had an uneventful recovery and

was discharged from hospital. Subsequent follow up has established that the patient remains well since her surgery.

Case 2

A 19-yr-old male presented for VATS bullectomy and right-sided pleural abrasion for bullous disease

Fig. 2 The Coopdech bronchial blocker (removed and replaced in Case 1) showing its fractured tip and the associated endotracheal tube

Fig. 3 The fractured tip of the bronchial blocker showing its hooking effect on the endotracheal tube in Case 1

complicated by spontaneous pneumothoraces. He had a history of well-controlled asthma and underwent a left-sided bullectomy ten months earlier. His chest x-ray revealed no abnormality of trachea or major bronchi.

Following induction of anesthesia, his trachea was intubated with an 8.5 mm ID tracheal tube cut at 26 cm. A Coopdech bronchial blocker was inserted into the tracheal tube to a depth of less than 20 cm from the connector. After this, a bronchoscope was passed through the dedicated port to visualize the advancing tip of the bronchial blocker, which was being caught repeatedly in the Murphy's eye of the tracheal tube. As a result, the blocker was withdrawn slightly and rotated 90° so that its tip pointed anteriorly and advanced past the Murphy's eye. However, despite repeated attempts under bronchoscopic guidance, it was not possible to place the tip in the right main bronchus. Consequently, the blocker was removed and examination of the tip of the removed bronchial blocker revealed marked angulation when compared with the tip of an unused Coopdech bronchial blocker (Figure 4). A new Coopdech blocker was inserted successfully using the same maneuvers as described earlier. No undue force was used at any point, and fiberoptic bronchoscopy was used throughout insertion. Localized and minor mucosal trauma was observed near the carina, but there was no active bleeding. The surgery was carried out successfully; the patient had an uneventful recovery and was discharged from hospital without incident. On postoperative assessment, the patient experienced no untoward sequelae from this procedure.

Fig. 4 The fractured tip of the Coopdech bronchial blocker in Case 2 showing the increased angulation (right) compared with the normal blocker (left)

Discussion

Bronchial blockers are increasingly used for lung isolation during VATS procedures. They have been shown to be equally effective as DLTs^{4,5} and offer clear advantages in difficult airway anatomy and in the presence of tracheostomies.⁶⁻⁸ Many designs exist, each with unique advantages and disadvantages. However, none has been shown to be superior to its competitors.

The Fogarty venous embolectomy catheter is probably the least commonly used blocker in adults. It has the advantage of an incorporated stylet that can be pre-shaped and placed either intra-luminally or extra-luminally.³ Also, an 8 Fr Fogarty venous embolectomy catheter has been used to rescue suboptimal lung isolation following DLT insertion.⁹ However, the Fogarty catheter is not designed for lung isolation and has no channel for suctioning or administering oxygen. Its placement can be challenging, and it can be dislodged easily. Furthermore, the balloon is inflated to a high pressure, and with the availability of other devices, its use is limited mostly to pediatrics.

The following devices are currently in use: the wire-guided Arndt bronchial blocker, the Cohen blocker, the Fuji Blocker, the Coopdech Blocker and the Univent tube. The Arndt bronchial blocker is a wire-guided device that can be coupled with a bronchoscope to aid correct placement. Arndt blockers can be passed orally, nasally, or through a tracheostomy tube, and they have a central channel for suctioning.^{6-8,10} The bronchial blocker cuff is designed to minimize dislodgement; however, the wire loop has to be removed once correct placement is achieved and repositioning is difficult without the wire loop.⁸ The Cohen blocker was devised to overcome this drawback. It has a flexible tip that can be inserted into the desired bronchus by rotating a wheel mechanism, and the same mechanism facilitates reinsertion if needed. It has a central aperture for limited suctioning and oxygenation plus a multiport adaptor for simultaneous fibreoptic bronchoscopy.¹¹ In inexperienced hands, it can be difficult to maneuver the blocker into the desired bronchus, as the wheel mechanism creates a large curvature rather than an angulation.¹²

The Univent tube has been in use long before the Fuji and Coopdech blockers. It is a single-lumen tube, which has the Univent blocker incorporated into its assembly. The blocker has a fixed curvature for easier manipulation. Consequently, its placement is relatively quick and easy to achieve, and it can be used during rapid sequence induction.¹³ Also, this design enables conversion to conventional single-lumen ventilation by simply deflating the blocker cuff and withdrawing it into its channel. Although the blocker is flexible and made with soft non-latex material, lung rupture and pneumothorax during blind insertion have been reported.¹⁴ Therefore, bronchoscopic guidance is

advocated during placement. The Univent tube can become fragmented or fractured, though this is rare.¹⁵ Furthermore, the blocker cannot be separated from its assembly and can be used solely with the Univent tube.

The Fuji blocker, like the Univent device, has a preformed angulation at its tip to facilitate insertion into a desired bronchus. The distal tip of the Coopdech bronchial blocker has a similar preformed angulation (Figure 1). Unlike the Univent tube, these blockers come separately for use. Also, an enhanced connector is designed to facilitate continuous fibreoptic monitoring, and use of these devices has been described in patients with abnormal airway anatomy.¹⁶ In such circumstances, it is expected that repositioning a displaced Coopdech blocker would be easier than repositioning a wire-guided endobronchial blocker. It is also possible to block a lobar bronchus selectively. However, because of the relatively rigid frame of the blocker, there is potential for injury to airway structures; hence, the manufacturer recommends placement under continuous fibreoptic guidance.^A However, there are no reports, to date, of complications with the use of Coopdech or Fuji bronchial blockers.

We use Coopdech blockers in our institution for VATS procedures because they are simple to use, and they can be repositioned easily. In our first patient, it is impossible to know for certain how the bronchial blocker was partially fractured, as the blocker was inserted prior to bronchoscopic confirmation. The length of the connector is 5 cm. As the resistance encountered during initial insertion through the tracheal tube (cut at 26 cm) occurred before the 30 cm mark at the connector level, we suspect that the angulated tip of the blocker may have been caught in the Murphy's eye of the tracheal tube. The tip may have been damaged either at this point during the initial resistance or at the carina with further insertion. The absence of tracheal or bronchial injury on subsequent bronchoscopy may favour the former etiology, though it is difficult to rule out the latter.

In our second patient, we observed repeated obstruction at the Murphy's eye during insertion under bronchoscopic guidance. Negotiation past the Murphy's eye was only possible by rotating the blocker away through 90°. We hypothesize that the blocker tip was damaged at the Murphy's eye during attempts to advance past it, thus making it impossible to position the blocker in the right main bronchus. Further damage to the tip could have been possible at the carina. Since no undue force was exerted during insertion of the blocker in both of our patients, we can only surmise that minimal force is sufficient to cause tip fracture.

^A Coopdech endobronchial blocker: Product brochure and instruction manual. Smiths Medical International, UK. Available from URL: <http://www.smiths-medical.com/plugins/news/2007/sep/endo-bronchial-blocker.html> (accessed December 2009).

It is not surprising, in both instances, that partial fracture of the bronchial tip occurred when attempting to place the bronchial blocker in the right main bronchus, as the tracheal tubes used in our institution have the Murphy's eye on the right side. Both of these incidences were reported to the distributor (Smiths Medical International Ltd, Watford, UK) for further investigation to exclude the possibility of a structural weakness at the distal angulation of the blocker. A subsequent manufacturer's quality assurance review of the bronchial blocker from the first incident indicated no anomalies. In their reply, the manufacturer felt that the initial resistance could have been due to the tip coming into contact with the carina, which might have caused the blocker to kink in some way due to the force of insertion. They reiterated the need for continuous monitoring by bronchoscopy through all the stages of insertion as according to their recommendations.

In conclusion, though the angulated tip of the Coopdech bronchial blocker may offer an advantage in its placement, the same design can make it susceptible to being caught in the Murphy's eye or at the carina, resulting in tip fracture. This is particularly so in right-sided bronchial blocker placement, even with continuous bronchoscopic-guided insertion. Hence, we suggest that extreme care be taken in the placement of Coopdech bronchial blockers, especially when isolation of the right main bronchus is attempted. It should be inserted under continuous bronchoscopic guidance as recommended by the manufacturer. We also advocate turning the blocker tip 90° away from the Murphy's eye to facilitate insertion. Therefore, continuous bronchoscopy with such maneuvers should minimize the risk of accidental tip fracture during placement of the Coopdech endobronchial blocker.

Competing interests None declared.

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