PERIODICUM BIOLOGORUM
VOL. 127, No 1–2, 71–75, 2025
DOI: 10.18054/pb.v127i1-2.35572

UDC 57:61
CODEN PDBIAD
ISSN 0031-5362

Review article

New life for Univent™ tubes

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Keywords: hemoptysis; endotracheal intubation; artificial respiration; bronchial blocker; one-lung ventilation

Abbreviations
BB – bronchial blocker
CPAP – continuous positive airway pressure
OLV – one-lung ventilation

Received March 19, 2025
Revised June 19, 2025
Accepted July 11, 2025

Abstract

Background: *The advancement of diagnostic methods and the identification of new indications have presented the anesthesiology team with the critical task of maintaining patients' airways. It is essential to ensure optimal oxygenation and effectively manage airway bleeding.*

Methods: *A review of relevant literature was conducted to assess the clinical applications, advantages, and limitations of the Univent™ endotracheal tube with an integrated bronchial blocker. Databases such as PubMed, Scopus, and ScienceDirect were searched for peer-reviewed articles published in English.*

Conclusion: *The Univent™ tube with a bronchial blocker (BB) is vital for one-lung ventilation and bronchial isolation. While this tool provides significant benefits in scenarios requiring one-lung ventilation, there are important drawbacks to consider, including the risk of tube displacement, difficulties in placement, limited access for suctioning, and potential complications related to the airway.*

INTRODUCTION

The advancement of diagnostic methods in pulmonology presents new challenges for anesthesiologists. Pulmonologists are seeking better and simpler ways to evaluate lung lesions, while anesthesiologists focus on ensuring adequate oxygenation and minimizing the risk of complications. Both specialties prioritize patient safety and aim to obtain satisfactory diagnostic specimens. One potential complication that can be fatal is hemoptysis *(1).* In such cases, death usually results from airway obstruction and the subsequent inability to exchange gases at the alveolar-capillary membrane, rather than from hemorrhagic shock *(2).*

Effective airway management is crucial for ensuring patient safety during pulmonary diagnostic procedures *(3).* A thorough assessment of the airway is essential before any bronchoscopic procedure, which is typically performed under moderate sedation or general anesthesia. Depending on the patient's specific needs and the anticipated complexity of the procedure, either Univent tubes or standard endotracheal tubes may be used. Careful airway monitoring using capnography and pulse oximetry is vital throughout the procedure.

If the procedure involves a biopsy or manipulation of tumors in the airways, there is a risk of bleeding. Active management of any bleeding and ensuring adequate gas exchange in the lungs is critical during the procedure. The choice of endotracheal tube is influenced by the patient's condition and the potential interventions required. To minimize bleeding, strategies such as suctioning to clear blood from the airway and maintaining effective ventilation may be employed. If bleeding occurs, the pulmonologist may administer vasoactive drugs (if appropriate for

the patient's comorbidities), antifibrinolytic drugs, or perform cauterization/coagulation if the source of bleeding is identified. Techniques for cauterization may include laser therapy, electrocautery, or argon plasma coagulation. In extreme cases, surgical intervention may be necessary *(4)*.

In situations of critical hemoptysis, isolating the bleeding lung may be essential to ensure proper gas exchange and safeguard the unaffected lung. At our institution, we have found that the Univent tube paired with a bronchial blocker (BB) is an effective method for airway protection during episodes of severe endobronchial bleeding.

HISTORY

The Univent™ tube was first introduced in the early 1980s by Fuji Systems Corp., Tokyo, Japan *(5)*. This single-lumen tube features a movable balloon (BB) that is integrated into its concave anterior wall, serving as an alternative to dual-lumen tubes. The balloon runs through the single-lumen tube and can be inflated to selectively block a specific bronchus *(6)*. Designed for safe airway management, the Univent™ tube is used in procedures requiring general anesthesia, resuscitation, or mechanical ventilation, and it provides an alternative to double-lumen tubes (DLT). To ensure accurate placement of the blocker, a fiberoptic bronchoscope is required. Additionally, the small lumen in the blocker can be utilized for various types of ventilation for the isolated lung segment, including jet ventilation, oxygen supplementation, and continuous positive airway pressure (CPAP) *(9,10)*. Many Univent™ tubes also feature a Murphy eye, which provides an alternate air passage if the main tube opening becomes blocked. Some models include a radio-opaque line, making the tube visible on X-rays for easier confirmation of placement.

USE OF THE UNIVENT™ TUBE

Currently, there are several semi-invasive and invasive diagnostic methods available for diagnosing or ruling out various lung diseases. Some of these procedures, such as bronchoscopy, have been used for many years, while others, like electromagnetic navigation with integrated digital tomosynthesis, represent newer innovations.

Depending on the level of invasiveness and the potential for complications, some methods may require the isolation of one lung. In these cases, the Univent™ tube with a BB can be used for bronchial isolation. This tube provides a safe way to block one bronchus while allowing ventilation in the other lung. This is particularly advantageous when the procedure involves manipulating or biopsying a lung lesion, as it enables visualization of tumors or lesions without compromising the ventilation of the unaffected lung.

The primary indications for using the Univent™ tube with a BB arise in specific clinical scenarios where one-lung ventilation (OLV) or bronchial isolation is necessary, particularly when there is a risk of hemoptysis and postoperative ventilation is anticipated. One of the advantages of this tube is its ability to selectively block individual lung lobes and ease its passage through the larynx. Furthermore, unlike dual-lumen tubes, the Univent™ tube does not need to be replaced at the end of surgery if prolonged respiratory support is required *(11)*.

It is essential to take proactive steps to prevent blood aspiration and ensure effective oxygenation while treating the underlying cause of bleeding. By focusing on these actions, we can protect the patient's well-being, reduce the risk of complications, and promote a more successful recovery. Proper oxygenation is vital not only for immediate survival but also for supporting the body's healing processes. Your attention to these critical factors can significantly impact patient outcomes.

Situations that may require the use of a Univent tube with a BB include *(12,13)*:

1. Thoracic surgeries, such as lobectomy, pneumonectomy, and esophagectomy
2. One-lung ventilation (OLV) used for lung isolation
3. Treatment of massive hemoptysis, including isolation of the bleeding lung
4. Bronchoscopy or bronchial procedures that require bronchial isolation
5. Management of trauma-related lung injuries needing lung isolation
6. Difficult airway management, especially in cases of small or obstructed airways
7. Treatment of pulmonary diseases, including chronic obstructive pulmonary disease (COPD) and acute respiratory distress syndrome (ARDS)
8. Lung transplant surgeries
9. Pediatric cases involving small airways or congenital anomalies
10. Management of acute lung injury or ARDS where lung isolation improves treatment

In these scenarios, the Univent tube with a BB enables selective lung isolation and OLV, optimizing surgical access, preventing complications such as blood aspiration, and improving ventilation management. This approach is especially useful in patients with anatomical challenges or difficult airways where traditional methods like DLTs may be suboptimal *(14)*.

Advantages

The benefits of using a Univent™ tube with a BB include *(11,14,15)*:

– Easier to place: Compared to a DLT, the Univent™ tube is simpler to insert. Its flexibility is particularly advantageous for patients with difficult airways.
– Reduced risk of complications: The integrated design minimizes complications associated with other OLV techniques.

– Minimized risk of injury: The BB reduces the chance of tracheal trauma or bronchial damage, which is especially important for patients requiring long-term ventilation.

Overall, a BB is particularly effective for patients who are challenging to intubate and serves as a better option for smaller-diameter airways when a DLT is too large. Additionally, it enables the targeted isolation of a specific lung area, which can be extremely beneficial.

Disadvantages

Despite its utility, the bronchial blocker and Univent™ tube system presents several limitations *(13,15,16):*

– Placement complexity: Accurate placement requires fiberoptic bronchoscopy, and the BB may shift, necessitating frequent position checks.
– Incomplete lung collapse: Obstructed lungs may only partially deflate, making ventilation more difficult.
– Limited suctioning: The narrow lumen restricts the ability to suction secretions effectively, compromising airway management.
– Difficult reinflation: Small internal channels reduce the efficiency of lung reinflation.
– Resource-intensive: Requires fiberoptic bronchoscopy and specialized training, which may not be universally available.
– High-pressure risks: Improper use of the BB can lead to barotrauma or inadequate lung isolation.
– Learning curve: Operators require specific technical training, and inexperience can lead to incorrect placement and adverse outcomes.

The Univent™ tube with a BB is a useful tool for OLV and bronchial isolation. However, its usage has declined in favor of other techniques and devices. Several factors contribute to this decrease in popularity, despite its potential benefits. These factors include technical challenges, performance limitations, and advancements in alternative airway management options. Here are the main reasons why the Univent™ tube with BB is no longer widely used:

Difficulties in proper positioning and management:

Movement of the bronchial blocker: One of the main disadvantages of the Univent™ tube with a BB is the challenge of maintaining its correct position. If the blocker becomes dislodged, it can result in inadequate isolation of the lung, compromising both ventilation and oxygenation. This issue is a common technical problem that can lead to a loss of lung isolation, which is crucial in surgeries that require OLV *(15,17)*.

Challenges with patients who have complex anatomy: While the Univent™ tube with a BB is generally easier to place than a DLT, it can still be challenging to insert in patients with anatomical variations or difficult airways. In some situations, placing it may be more difficult than using a single-lumen tube or a DLT, requiring specialized skills for proper insertion.

Need for continuous monitoring: A BB often necessitates more frequent adjustments during the procedure, making it more challenging to manage than a DLT, which tends to be more stable and typically does not require repositioning as often (*18)*.

Performance limitations in certain procedures:

Suboptimal lung isolation: In certain situations, a BB may not achieve lung isolation as effectively as a DLT. For instance, during surgeries that necessitate precise control of ventilation in both lungs or involve highly specialized procedures, a Univent™ tube with a BB may not provide the same level of reliable isolation or ventilation control *(15)*.

Limited suction access is a notable drawback of the Univent™ tube with a BB compared to a DLT. This limitation can be significant during procedures that require frequent or extensive bronchial suctioning, such as lung resections or tumor surgeries. The restricted access to suctioning and bronchoscopic procedures may pose challenges in managing secretions or controlling bleeding effectively (*19)*.

Technological progress and improved alternatives:

DLTs: The DLT is widely regarded as the gold standard for OLV and bronchial isolation. DLTs are more stable and provide reliable lung isolation with a reduced risk of displacement. Additionally, they allow for easier suctioning and bronchoscopic access to both lungs. Due to these advantages, DLTs are the preferred option for lung isolation in many surgical procedures, which has resulted in a decreased demand for the Univent tube with a balloon BB.

Less flexibility and higher risk of complications:

Limited flexibility: The BB in Univent™t tubes may not offer the same level of flexibility during surgery or in situations that require frequent adjustments. The blocker might dislodge or fail to completely close the bronchus, which can result in inadequate isolation and increase the risk of aspiration or ventilation/perfusion mismatch.

Higher risk of complications: While Univent™ tubes with bronchial blockers can be effective in certain scenarios, they carry a higher risk of complications, such as airway obstruction, displacement of the blockers, or insufficient lung isolation. In contrast, DLTs provide safer isolation and are easier to manage (*15)*.

Training and experience requirements:

Using the Univent™ tube with a BB necessitates a specific level of skill and experience for proper insertion and placement. In settings where anesthesiologists or in-

tensivists may not be familiar with this technique, there is an increased risk of incorrect placement or inadequate lung isolation.*(6,20).*

The limited availability of training is a concern. As DLTs gain popularity and fiberoptic bronchoscopy becomes more widely accessible, fewer healthcare professionals are receiving training on how to use the Univent™ tube with the BB. Consequently, this technique is being used less frequently and is gradually being phased out in favor of more commonly employed methods.

Cost consideration:

Equipment cost: The Univent™ tube with BB is typically more expensive than both single-lumen and DLTs. This higher cost can make it a less appealing option for routine procedures, particularly in resource-limited settings. The combination of its elevated price, limited usage, and the availability of cheaper alternatives has led to a decline in its adoption.

Improved monitoring and management with DLTs:

Better ventilation control: DLTs offer enhanced control over the ventilation of both lungs, facilitating more effective management of oxygenation and ventilation during surgery. This is especially important in complex thoracic procedures. DLTs provide better isolation of the lungs, reduce the risk of underventilation, and simplify the management of lung recruitment and oxygenation.

The Univent™ tube with a BB offers specific advantages, particularly in managing difficult airways and serving as an alternative to DLTs for certain surgical procedures. However, its limitations in performance and reliability have led to a decline in its usage over time. Consequently, the DLT has become more prevalent. Many hospitals and surgical centers have significantly reduced their use of the Univent™ tube with BB, especially as advancements in technologies like fiberoptic bronchoscopy have made DLT placement more accessible and dependable. Nonetheless, appropriate training and follow-up are crucial to ensure the effectiveness of the Univent™ tube and to prevent complications, such as blocker displacement or inadequate lung isolation. Currently, there is no consensus on the best method for lung isolation during ventilation. We believe that the Univent™ tube with broncho-blocker remains a valuable tool for diagnostic procedures in pulmonology.

As the range of pulmonary diagnostic procedures continues to expand, anesthesiologists are facing new challenges. These procedures range from semi-invasive conventional bronchoscopy to the latest technology, such as Illumicite. Some procedures can be performed under mild sedation, while others require general anesthesia and airway protection. Many anesthesiologists may not yet be fully aware of the challenges they will soon encounter.

Challenges and Considerations

Airway management: The Univent™ tube with BB is a valuable tool in many cases, but it necessitates close monitoring of ventilation and potential blockage. If the BB is not functioning correctly or becomes dislodged, it can lead to inadequate ventilation or oxygenation.

Correct placement: Proper placement of the tube is crucial for effective lung isolation. Incorrect placement can obstruct the wrong bronchus, resulting in ventilation issues.

Ventilation assessment: It is essential to regularly assess ventilation pressures and oxygenation throughout the procedure to ensure that both lungs are being managed effectively. If the tube becomes dislodged, it may lead to ventilation of both lungs, compromising the OLV strategy.

While the Univent™ tube with BB offers several advantages, especially in procedures requiring OLV, it also presents significant drawbacks, including the risk of displacement, difficulties in placement, limited access for suctioning, and potential airway complications. Therefore, it may not be suitable for all surgical situations and requires ongoing monitoring to ensure effective lung isolation and oxygenation. These limitations should be carefully considered alongside the benefits of using the Univent™ tube, and the decision to utilize it should be made based on the specific clinical context and the expertise of the medical team.

CONCLUSION

The Univent™ tube with a BB remains a viable option for OLV and bronchial isolation, particularly in cases involving difficult airways, high-risk bleeding, or specific pulmonary procedures. While DLTs have largely supplanted Univent™ tubes in many surgical settings due to superior stability and ease of use, the Univent™ system offers unique advantages in selected cases. Its continued relevance depends on clinical context, operator expertise, and institutional resources.

Acknowledgments: *We have no conflicts of interest to disclose regarding this topic.*

Authors' Contributions: NP conceived the study. NP, APB, and LŠ collected data. NP and MKI drafted the manuscript. DS and NPŽ revised the draft. All authors approved the final version.

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