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Complications in the Use of the Montgomery T-Tube in a Mechanical Ventilation Weaning and Rehabilitation Center

Complicaciones en el uso de la Prótesis tipo Montgomery en un Centro de Desvinculación de la Ventilación Mecánica y Rehabilitación

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ABSTRACT

Background: The Montgomery-type prosthesis, or Montgomery T-tube (MTG), is a device used for the treatment of various tracheal pathologies, such as stenosis and granulomas, as well as for postoperative management following tracheal surgery. Despite its widespread use, there is limited national evidence regarding its complications in respiratory rehabilitation settings. The objective of this study was to describe the complications associated with the use of MTG in a Mechanical Ventilation Weaning and Rehabilitation Center (MVWRC), including reasons for its placement, postoperative medical indications, discharge status, and survival.

Materials and methods: An observational, cross-sectional, and retrospective study was conducted, including patients aged ≥ 18 years admitted to the MVWRC from 2015 to 2023, who received or were indicated for MTG prosthesis placement during hospitalization. We analyzed clinical and demographic variables, postoperative indications, associated complications, duration of use, and patient discharge destinations.

Results: Fifteen patients were included, with a mean age of 53 years. The most frequent indication for placement was tracheal stenosis (53.3%). 93.3% of patients experienced at least one complication, mainly increased secretions and the need for aspiration. One third of the patients required emergency removal of the MTG. The median duration of use was 104.5 days, and survival rate at discharge was 80%.

Conclusion: Most patients with a MTG experienced complications during hospitalization, with emergency removal being the most frequent intervention. Standardization of postoperative care protocols could reduce complications and optimize clinical outcomes.

Keywords: tracheal prostheses; tracheal stenosis; tracheostomy; respiratory rehabilitation; postoperative complications

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RESUMEN

Introducción: La prótesis tipo Montgomery o Tubo T de Montgomery (MTG) es un dispositivo utilizado para el tratamiento de diversas patologías traqueales, como estenosis y granulomas, así como en el manejo posoperatorio de cirugías traqueales. A pesar de su amplio uso, existe escasa evidencia nacional sobre sus complicaciones en contextos de rehabilitación respiratoria. El objetivo del estudio fue describir las complicaciones asociadas al uso de MTG en un centro de desvinculación de la ventilación mecánica y rehabilitación (CDVMR), así como los motivos de colocación, indicaciones médicas posquirúrgicas, condición de egreso y sobrevida.

Materiales y métodos: Se realizó un estudio observacional, transversal y retrospectivo que incluyó pacientes mayores de 18 años ingresados al CDVMR entre 2015 y 2023 con prótesis MTG colocada o indicada durante la internación. Se analizaron variables clínico-demográficas, indicaciones posquirúrgicas, complicaciones, duración del uso de la prótesis y destino al alta.

Resultados: Se incluyeron 15 pacientes con una mediana de edad de 53 años. El motivo más frecuente de colocación fue la estenosis traqueal (53,3%). El 93,3% presentó alguna complicación, principalmente aumento de secreciones y requerimiento de aspiración. Un tercio de los pacientes requirió el retiro de urgencia del MTG. La mediana de uso fue de 104,5 días y la sobrevida al egreso fue del 80%.

Conclusión: La mayoría de los pacientes con MTG presentó complicaciones durante la internación, siendo frecuente el retiro de urgencia. La protocolización de los cuidados posquirúrgicos podría reducir complicaciones y optimizar los resultados clínicos.

Palabras clave: prótesis traqueales; estenosis traqueal; traqueostomía; rehabilitación respiratoria; complicaciones posoperatorias

INTRODUCTION

The Montgomery-type prosthesis, also known as the Montgomery T-tube (MTG), was invented in 1962 by William Montgomery, a physician at Harvard Medical School and the Department of Otolaryngology at Massachusetts General Hospital.[1]

The prosthesis was initially used to prevent tracheal stenosis following post-traumatic reconstructive surgery. Originally, the T-tube was made of acrylic material, complicating insertion and impairing ciliary function, which hindered upper airway secretion mobilization and expectoration. In 1986, the company Boston Medicals developed the so-called "Safe T-Tube,"[2] manufactured from silicone material, which facilitated placement and, in addition, its smoother internal and external walls helped prevent pressure-related injuries such as granulomas, while preserving ciliary function and expectoration, and reducing secretion adherence to the tube.[3]

The prosthesis is composed of an internal structure formed by two intrathoracic limbs –an upper and a lower one– which shape the tracheal lumen, and it has an external limb that exits through a tracheal stoma. This limb secures the device and reduce displacement, allowing it to be opened to access the interior of the prosthesis in order to maintain its patency.[4] The length and diameter of the internal limbs of the prosthesis vary and must be customized according to measurements of the patient's airway, ranging from 4.5 to 16 mm in external diameter. In adults, sizes between 11 and 14 mm are commonly used. Regarding its length, it must be ensured that the upper limb is positioned at least 0.5 to 1 cm away from the vocal cords and that it is not placed in a transcordal position.[5]

In 2005, Wahidi and Ernst emphasized the importance of preserving phonation and proper humidification of inspired air by ensuring correct prosthesis placement and avoiding continuous opening of the external limb.[6]

Currently, the prosthesis is used for the treatment of conditions such as tracheal stenosis, following granuloma resection, and as a postoperative intervention after tracheal anastomosis secondary to tracheomalacia or acute tracheal trauma.[7,8]

The placement technique may vary; it is generally inserted through a pre-existing stoma created

at the time of securing the airway with a tracheostomy cannula, which facilitates placement and ensures adequate ventilation during the procedure.[9-10] It may also be placed via a direct surgical approach.[11] In either case, the procedure is performed under general anesthesia, and the use of rigid fiberoptic bronchoscopy is essential for proper placement and confirmation of MTG positioning.

Immediate surgical complications are directly related to anesthesia. The most common include excessive bleeding at the insertion site, respiratory distress due to incorrect placement, and infections, among others that occur beyond the immediate postoperative period are not usually well described in the available literature. In a 1996 article, Martínez-Ballarín et al described three main complications: the most frequent was prosthesis migration, followed by granuloma formation at the distal edges of the prosthesis and obstruction due to large amounts of secretions.[12,13] Another complication reported in the literature is displacement, either proximal or distal, with subsequent partial or complete aspiration of the prosthesis following obstruction by secretions.[14-16]

The objective of the present study was to describe the complications that occurred in patients with Montgomery-type prostheses that ocurred at a Mechanical Ventilation Weaning and Rehabilitation Center (MVWRC). Secondarily, to describe the reasons for placement, postoperative medical indications, discharge status, and survival of patients with Montgomery prostheses.

MATERIALS AND METHODS

An observational, cross-sectional, retrospective study was conducted, including patients ≥18 years admitted to the MVWRC between January 1, 2015, and December 31, 2023, who had a MTG-type prosthesis in place or required its placement during hospitalization. Patients with missing data for the analysis of the main variables were excluded.

Clinical and demographic variables, as well as variables recorded during admission to the MVWRC, were described. Data on prosthesis placement indications, postoperative medical conditions, complications, discharge destinations, and other variables were recorded. Descriptive statistics values were expressed as frequencies and percentages for qualitative variables, and as median and first and third interquartile ranges (IQR 1–3) or mean and standard deviation for quantitative variables.

Statistical analysis was performed using R software, version 4.2.3.

RESULTS

Fifteen subjects were included, with a median age of 53 years [IQR 1-3, 43.5-71], 40% of whom were male, and with a median Charlson Comorbidity Index of 2 points [IQR 1-3, 0.5-3.5].

Most patients were admitted to the MVWRC with a tracheostomy cannula and required MTG placement as part of the decannulation process (53.3%); the rest were admitted with the prosthesis already in place.

Regarding the reasons for placement, most patients had tracheal stenosis (53.3%), followed by the presence of granulomas (20%), among others. Upon admission, 10 out of 15 patients had postoperative medical indications, the most frequent being instillation of normal saline through the prosthesis (26.7%), nebulization with normal saline using an oronasal mask (26.7%), and aspiration through the external limb of the prosthesis (20%).

Complications were observed in 93.3% of the subjects. The most common complication was the need for aspiration through the prosthesis (93.3%), followed by an increase in the amount and quality of secretions (80%). Additional complications included dyspnea, pneumonia, the need for noninvasive ventilation (NIV), desaturation (a sudden decrease in oxygen saturation below 92% not attributable to secretions and not improving with aspiration), and others (pain at the site, tracheal stoma injury due to prosthesis pressure, stridor, and aphonia). One third of the subjects required emergency removal of the prosthesis (three due to obstruction and two due to malposition), while one individual self-removed the MTG and subsequently refused reinsertion. Only three subjects achieved elective removal.

The median duration of MTG use was 104.5 days [IQR 1-3, 10.75-244]; the median length of stay in the MVWRC was 350.5 days [IQR 1-3, 187.2-624], and the survival at discharge was 80% (n = 12), of whom 50% were discharged home (four with the prosthesis in place and two with a tracheostomy cannula).

DISCUSSION

Based on the reviewed literature, this study is the first in our country to report the characteristics and common complications in subjects with MTG-type prostheses.

TABLE 1. Descriptive analysis

Descriptive analysis	
N	15
Age#	53.00 [43.50, 71.00]
Male biological sex*	6 (40.0)
Reason for ICU admission*	
STROKE/TBI	4 (26.7)
Exacerbated COPD	3 (20.0)
COVID pneumonia	3 (20.0)
Other	5 (33.3)
Charlson Comorbidity Index#	2.00 [0.50, 3.50]
Admission with TQT*	8 (53.3)
Days of TQT prior to Montgomery#	161.00 [125.25, 278.00]
Reason for Montgomery placement*	
Edema	1 (6.7)
Stenosis	8 (53.3)
Tracheoesophageal fistula	2 (13.3)
Granuloma	3 (20.0)
Malacia	1 (6.7)
Topography of lesion*	
Trachea	11 (73.3)
Larynx	4 (26.7)
Postoperative indications*	
Aspiration	3 (20)
Instillation	4 (26.7)
Keep opened	1 (6.7)
Nebulization	4 (26.7)
None	5 (33.3)
No aspiration	1 (6.7)
Transcordal placement*	3 (20.0)
Complications at the MVWRC*	14 (93.3)
Increased secretions	12 (80.0)
Aspiration through Montgomery tube	14 (93.3)
Dyspnea	6 (40.0)
Oxygen saturation below 92% on room air	8 (53.3)
Pneumonia	4 (26.7)
NIV	3 (20.0)
Other	6 (40.0)
Removal of Montgomery tube*	9 (60.0)
Reason for removal*	
Elective	3 (33.3)
Malposition	2 (22.2)
Obstruction	3 (33.3)
Other	1 (11.1)

(continúa)

(continuation)

Descriptive analysis	
Days with MTG in the MVWRC#	104.50 [10.75, 244.00]
Hospitalization days at the MVWRC#	350.50 [187.25, 624.00]
Discharged alive from the MVWRC*	12 (80.0)
Discharge destination*	
3rd level	1 (8.3)
Acute Care Center	3 (25.0)
Home	6 (50.0)
Remains hospitalized	2 (16.7)

#=Data expressed as median and 1st–3rd quartile
*= Data expressed as frequency and percentage
ICU: Intensive Care Unit; TBI: traumatic brain injury; COPD: chronic obstructive pulmonary disease; TQT: tracheostomy; MVWRC: Mechanic Ventilation Weaning and Rehabilitation Center; NIV: non-invasive ventilation

First, most subjects required placement of the prosthesis secondary to a tracheal injury, the most frequent being subglottic stenosis, reducing the tracheal lumen by more than 60%.

Second, when analyzing postoperative indications, most patients were admitted with some type of instruction from the treating medical team. The most frequent instruction was routine instillation and aspiration through the external limb of the prosthesis. Considering that the MTG is made of silicone material, with the aim of preserving proper mucociliary function, this type of indication may lead to contamination of the tracheobronchial tree due to periodic opening of the prosthesis.

Third, most subjects experienced some type of complication during hospitalization associated with the use of the prosthesis, the most frequent being the need for aspiration through it, secondary to an increase in both the quantity and quality of secretions, with episodes of sudden desaturation below 92% while breathing room air. This findings are consistent with what has been reported in the literature by Martínez-Ballarín[12] in 1996 and by Noirez[16] in 2015, who also observed distal displacement of the prosthesis was also associated, secondary to total or partial obstruction by secretions. Regarding the increase in secretions observed in patients, it was not possible in this study to record the time interval between placement and the onset of these symptoms, since the MTG ultimately represents a foreign body in the airway.

Fourth, it was reported that one third of the subjects required emergency removal of the MTG and placement of a tracheostomy tube due to complete obstruction and malposition of the prosthesis, secondary to both proximal and distal displacement. It is not possible to rule out the possibility that these emergency removals were due to an inappropriate prosthesis sizing for the patient's airway. It is essential to conduct a prior evaluation of airway anatomy by computed tomography before placement in order to select the appropriate length and internal diameter of the device.[17] Only three patients underwent elective removal, and of these, the prosthesis was successfully removed in only one case.

Fifth, survival at discharge was 80%. Although several complications occurred during prosthesis use, they were successfully managed during hospitalization. When removal MTG was required, the airway could be rapidly secured with a tracheostomy tube.

Finally, this study has limitations. Fewer than half of the patients were admitted to the MVWRC with the prosthesis already in place; therefore, information prior to placement –such as baseline respiratory function values and the severity of the tracheal lesion– was not available. Likewise, the time interval between prosthesis placement and the onset of any of the described complications was not recorded. In addition, follow-up of subjects was performed only until discharge, with no follow-up of patients who were discharged home with the prosthesis still in place. Further scientific studies are needed to specifically analyze the statistical association between complications and the presence of the prosthesis.

CONCLUSION

Most subjects with MTG prostheses experienced some type of complication during their stay at the MVWRC, of whom one third required emergency removal. Standardization of postoperative care protocols could reduce these complications and improve the success rate of their use.

In this series of patients with Montgomery-type prostheses treated at a Mechanical Ventilation Weaning and Rehabilitation Center, complications were highly prevalent, affecting the vast majority of patients, with the need for emergency removal of the device in approximately one third of cases.

These findings highlight the fact that, although the Montgomery-type prosthesis is a useful tool in the management of certain airway pathologies, its use is not without clinically relevant risks, particularly in the context of prolonged hospitalization and in patients with a high burden of comorbidities.

Standardization of postoperative care, appropriate selection of device size and positioning, and providing specific training to the healthcare team could help reduce complication rates and improve the success rate of this device. Prospective studies with larger patient populations are needed to identify factors associated with complications and to optimize follow-up and management strategies for this prosthesis in the field of respiratory rehabilitation.

Conflict of interest

The authors have no conflicts of interest to declare in relation to this publication.

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