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JCIMCR OPEN ACCESS Journal of Clinical Images and Medical Case Reports

ISSN 2766-7820

Case Series

Open Access, Volume 5

Evaluating interventional strategies for tracheal granulation in post-tracheostomy patients: Insights from a case series

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Received: Aug 03, 2024
Accepted: Aug 21, 2024
Published: Aug 28, 2024
Archived: www.jcimcr.org
Copyright: © Bhatt S (2024).
DOI: www.doi.org/10.52768/2766-7820/3226

Abstract

Introduction: Tracheal granulation tissue, commonly occurring after a tracheostomy, can result in severe consequences such as airway blockage. This case series examines the efficacy of electro-cauterization when combined with balloon dilatation and tracheal stenting to treat this condition.

Methods: This study consisted of a retrospective case series involving five patients who received intervention at a tertiary care center from January 2022 to July 2023. The selection of interventions was based on the severity and location of the granulation tissue. Patients with tracheomalacia were treated with either electro-cauterization combined with balloon dilatation or tracheal stenting. Follow-up examinations were performed to monitor clinical outcomes for six months post-treatment.

Results: All patients had a complete recovery without any recurrence of symptoms. The therapies were effective in maintaining airway patency and allowed the removal of the tracheostomy tubes. The absence of any consequences indicates the strong effectiveness and safety of these procedures.

Conclusion: The combination of electro-cauterization, balloon dilatation, and tracheal stenting was found to be useful in treating tracheal granulation after tracheostomy, particularly in difficult cases. These findings indicate that these interventions can be regarded as reliable options for identical instances. Further studies with larger sample sizes and prospective designs are recommended to validate these findings and potentially influence treatment protocols.

Keywords: Tracheostomy; Tracheal granulation; Airway obstruction; Diagnostic imaging; Interventional management.

Introduction

A tracheostomy is an imporatnt procedure for patients needing long-term mechanical ventilation. It offers several advantages over prolonged endotracheal intubation, such as increased patient comfort and easier weaning. However, one of the significant challenges associated with tracheostomy is the formation of tracheal granulation tissue. This tissue growth, triggered by the tracheostomy tube, can significantly narrow and obstruct the airway, complicating the removal of the tracheostomy tube and often requiring additional interventions [1].

Managing tracheal granulation tissue is complex and requires a multi-faceted approach. Our case series explores various techniques based on the severity and location of the granulation, including electrocauterization, balloon dilatation, and, in severe cases, tracheal stenting. These diverse strategies underscore the necessity for personalized treatment plans, as recommended by studies advocating for interventions tailored to patient characteristics and the specific properties of the granulation tissue [2].

Electrocauterization has proven effective in removing localized granulation tissue while minimizing bleeding, a common complication in managing this condition [3]. Balloon dilatation provides a less invasive alternative, often used when granulation-associated stenosis is present, helping to restore airway patency without surgery [4]. When these methods are not sufficient, tracheal stenting offers a temporary or permanent solution to keep the airway open, especially in patients with complex airway anatomy or where previous treatments have failed [5].

Additionally, advanced diagnostic techniques such as bronchoscopy and computed tomography are crucial for accurately locating and assessing granulation tissue. These tools guide the selection of the most appropriate treatment strategy [6]. Understanding the challenges of tracheal granulation and applying varied interventions highlight the contributions of our case series to medical knowledge, suggesting future research directions.

Methodology

Study design and setting: This retrospective case series was conducted at a tertiary care center within a defence setup. The study reviewed patients who underwent tracheostomy and subsequently developed tracheal granulation tissue, leading to airway narrowing. The study period spanned from January 2022 to December 2022, with follow-ups extending to July 2023.

Case selection: A total of five patients diagnosed with tracheal granulation tissue post-tracheostomy were included in the study. Eligibility was confirmed through clinical examination, imaging studies, and histopathological analysis where applicable. The inclusion criteria encompassed patients of any age and sex who exhibited documented tracheal granulation leading to airway narrowing post-tracheostomy. Patients were excluded if they had incomplete medical records, lacked follow-up data, or if tracheal granulation was not identified as the primary cause of airway narrowing.

Data collection: Data were collected from medical records, covering demographics, medical history, indications for tracheostomy, onset of tracheal granulation, diagnostic methods, management strategies, and outcomes. The accuracy and completeness of the data extraction were verified at the end of the data collection process.

Diagnostic assessment: The diagnosis of tracheal granulation tissue was primarily based on:

CT imaging: Images showed tracheal lumen narrowing. Symptomatic changes were noted when the lumen reduction was between 50-75%. A reduction to ≤10 mm was associated with exertional dyspnea, and ≤5 mm narrowing correlated with dyspnea at rest or stridor [6] (Figures 1a-1c).

Bronchoscopy: Essential for identifying granulation tissue, confirming its precise location, and evaluating the impact of stenosis (Figures 2a, b).

Interventions and follow-up

Therapeutic interventions, including electro-cauterization, balloon dilatation, and tracheal stenting for tracheomalacia, were tailored to individual patient needs. Outcomes assessment included symptom resolution, decannulation success, and monitoring for complications or recurrences. Follow-up care involved regular evaluations and gentle suctioning, complemented by fiber-optic laryngoscopy every three months to verify the absence of granulation tissue recurrence.

Ethical approval: The study was approved by the Institutional Review Board of the hospital (IRB/CHAF/23 dated 17 Dec 22), adhering to ethical standards and ensuring patient confidentiality. Informed consent was obtained from all participants or their guardians.

Case presentation

Case 1: A 35-year-old male experienced frequent tube blockages and significant respiratory distress. Evaluations using laryngoscopy and Contrast-Enhanced Computed Tomography (CECT) confirmed tracheal granulation (Figure 2a). He was treated with a combination of electro-cauterization and balloon dilatation, which effectively alleviated his symptoms. He recovered without recurrence. This case illustrates the benefits of combining treatment modalities for acute intervention, especially in middle-aged patients, and demonstrates the efficacy of these treatments in quickly resolving symptoms.

Case 2: A 45-year-old male presented with similar respiratory problems. Laryngoscopy and CECT diagnosed tracheal granulation. He was treated with electro-cauterization and balloon dilatation, resulting in an uneventful recovery. This outcome underscores the reliability of the method and sets a benchmark for consistent treatment outcomes, reinforcing its routine clinical use.

Case 3: A 60-year-old male with recurrent respiratory distress was diagnosed with tracheal granulation via laryngoscopy and CECT (Figure 2b). Electro-cauterization combined with balloon dilatation was carefully adjusted for his age and potential comorbidities. His successful outcome highlights the treatment's adaptability to various demographics, including the elderly, ensuring both safety and efficacy.

Case 4: A 50-year-old male experienced recurrent tube

blockages and respiratory distress. The granulation tissue was removed using electro-cauterization, followed by balloon dilatation to restore airway patency. He showed rapid improvement in respiratory function, emphasizing the procedure's effectiveness in quickly restoring normal breathing and preventing further complications.

Case 5: A 5-year-old male presented a particularly challenging case due to his young age and the presence of tracheomalacia complicating his condition. Tracheal stenting was carefully performed (Figure 3) to address both the granulation and underlying structural weakness. This intervention successfully managed his condition, demonstrating the importance of customized treatments for specific anatomical and pathological issues in children.

Results

This case series analysed five patients treated for tracheal granulation tissue post-tracheostomy at a tertiary care center. The study covered a year, with follow-ups extending six months post-treatment, focusing on the efficacy and long-term outcomes of the interventions.

Overall effectiveness: All patients experienced a complete resolution of symptoms following their respective treatments.

Electro-cauterization with balloon dilatation: Four adult patients, aged 35 to 60, underwent this combined treatment. Each patient reported significant improvement in breathing and no recurrence of granulation tissue during the follow-up period. This intervention proved highly effective in restoring airway patency and alleviating symptoms associated with tracheal obstruction.

Tracheal stenting: The fifth case, a 5-year-old male with tracheomalacia, required tracheal stenting. This intervention successfully relieved airway obstruction symptoms, with the patient maintaining good respiratory function and no evidence of granulation recurrence at follow-up.

Clinical improvement and decannulation success: All patients achieved successful decannulation, demonstrating the treatments' effectiveness in facilitating recovery and restoring normal respiratory function. Regular clinical assessments and imaging during follow-up confirmed the absence of complications or the need for further surgical interventions.

Safety and tolerability: The treatments were well-tolerated, with no significant complications reported during or after the interventions. The careful selection of treatment modalities, tailored to the severity and location of the granulation and patient-specific factors such as age and underlying conditions, contributed to this success.

Treatment outcomes by age group: The interventions were effective across a diverse age group, highlighting the versatility and adaptability of the treatment approaches used. Adult patients benefited from non-surgical interventions that minimized recovery time and maximized treatment efficacy. The pediatric case underscored the importance of specialized approaches in managing complex conditions like tracheomalacia.

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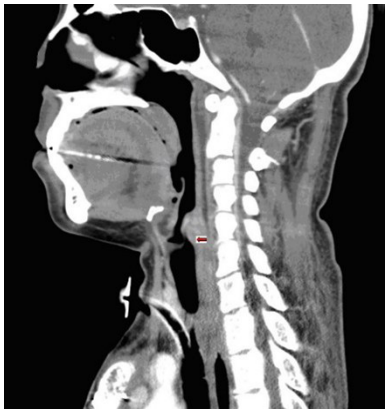

Figure 1a: CT (Coronal view) showing tracheal narrowing due to granulation.

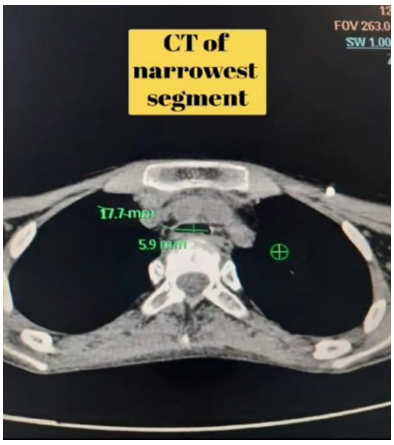

Figure 1b: CT showing narrowest section of trachea.

Figure 1c: CT scan showing narrowest section of trachea.

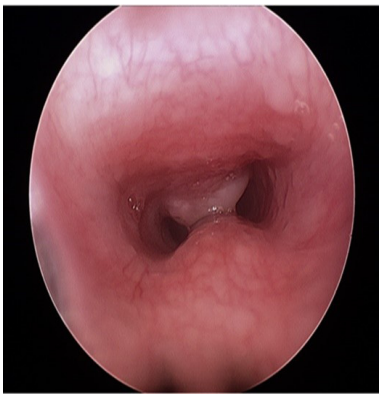

Figure 2a: Fibre optic bronchoscopy image showing granulation tissue & narrowing of trachea.

Figure 2b: Fibre optic bronchoscopy image showing closer view of granulation tissue.

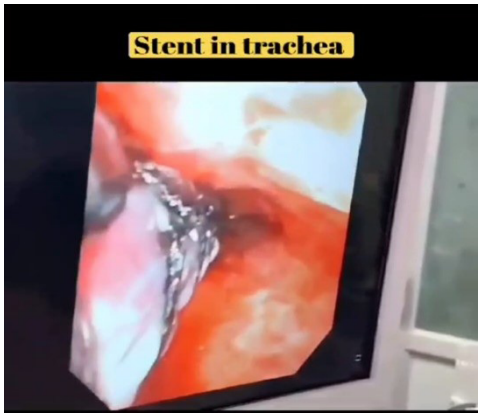

Figure 3: Fibre optic bronchoscopy image showing stent in trachea.

Discussion

The outcomes observed in this case series align with existing literature, demonstrating the effectiveness of targeted interventions such as electro-cauterization, balloon dilatation, and tracheal stenting in managing tracheal granulation tissue post-tracheostomy. These interventions are well-documented for their significant benefits in symptom resolution and reducing recurrence rates.

Electro-cauterization and balloon dilatation: The combination of electro-cauterization with balloon dilatation is a proven treatment for tracheal stenosis and granulation tissue removal. Nakahira and Nakatani highlighted the efficacy of this approach, particularly in maintaining airway patency [4]. Similar to our findings, their research reported no recurrence of granulation tissue post-treatment, affirming the durability of these interventions.

Tracheal stenting in paediatric cases: The successful use of tracheal stenting in our paediatric case aligns with recent advances in paediatric airway management. Madden et al. explored the role of stenting in complex paediatric airway diseases, noting improvements in airway stability and reductions in symptoms related to airway compression [3]. Our series supports this evidence by showing that stenting is a viable and effective option even in the presence of complicating factors like tracheomalacia.

Long-term outcomes and monitoring: Long-term follow-up is crucial for patients treated for tracheal granulation. Yaremchuk emphasized the necessity of regular monitoring to prevent complications such as recurrent stenosis [7]. Our systematic follow-ups were essential in ensuring the absence of recurrence and maintaining treatment success.

Clinical implications

The findings from this case series have significant implications for managing tracheal granulation tissue post-tracheostomy. The successful application of electro-cauterization with balloon dilatation and tracheal stenting shows that targeted, minimally invasive interventions can effectively resolve airway obstructions caused by granulation. These techniques are adaptable to various patient ages and conditions, including complex paediatric cases, broadening the scope of treatment protocols in otolaryngology and critical care settings. Clinicians should consider these methods as viable options, particularly in scenarios where conventional surgery might pose higher risks or require longer recovery periods.

Strengths and limitations

This case series effectively demonstrates the use of electro-cauterization and balloon dilatation in treating tracheal granulation, with comprehensive follow-up ensuring robust data on treatment durability. However, the small sample size and the absence of a control group limit the generalizability of the results. Future studies should build on these findings with larger, prospective designs to enhance validity.

Innovations and future directions

While our case series corroborates existing studies, it also highlights the need for continued innovation in treating tracheal granulation, particularly in paediatric populations. The evolving landscape of airway management techniques calls for ongoing research to refine and expand therapeutic options, ensuring they are both effective and minimally invasive.

Conclusion

This case series enhances the understanding of effective strategies for managing tracheal granulation post-tracheostomy. It supports the ongoing use of electro-cauterization and balloon dilatation as standard care for adults, while also highlighting the potential of tracheal stenting in addressing complex paediatric cases. The positive outcomes and absence of complications underscore the importance of tailored interventions based on individual patient characteristics and the necessity of rigorous follow-up protocols.

Declarations

Conflict of interest: The authors declare no conflicts of interest.

Research ethics: This research did not involve human participants or animals.

Consent: Informed consent was provided by the caretakers for the publication of this case series.

Funding: No external funding was received for the preparation of this manuscript.

Disclosure: The authors have no financial or non-financial interests relevant to the content of this manuscript to disclose.

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