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ACQUIRED TRACHEOESOPHAGEAL FISTULA IN A TEENAGE GIRL IN THE INTENSIVE CARE UNIT

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Abstract

Acquired tracheoesophageal fistula (ATEF) is a rare but serious complication of prolonged invasive ventilation and nasogastric feeding, occurring more frequently in younger patients. A fourteen-year-old girl who developed ATEF after a long stay in the intensive care unit (ICU) due to cerebral venous thrombosis and subsequent seizures is successfully managed in this case report. The patient experienced chronic choking, frequent respiratory infections, and trouble eating due to aspiration phobia. The diagnostic tests confirmed the existence of a high-level ATEF. A strong sternocleidomastoid muscle flap was used to correct the defects in the trachea and esophagus, where the esophagus was closed transversely and the trachea closed vertically. In that case, after a straightforward post-operative course, the patient's respiratory disorders improved dramatically, and on the fifth day, he returned to taking oral feeds. At the six-month follow-up visit, the patient had no residual symptoms, and repeat imaging confirmed that the fistula had completely closed. It is only through early diagnosis and the conduct of tailored surgical procedures as well as careful post-operative monitoring that iatrogenic ATEF can be effectively managed in children.

Keywords: Acquired Tracheoesophageal Fistula (ATEF), Pediatric, Iatrogenic, Sternocleidomastoid Muscle Flap, Surgical Closure, Prolonged Ventilation, Cerebral Venous Thrombosis.

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1. INTRODUCTION

An abnormal connection between the trachea and esophagus known as an acquired tracheoesophageal fistula may arise from a variety of external events such as trauma, infection, cancer, or medical procedures. Although the disorder is a clinical entity of note, in iatrogenic forms of tracheoesophageal fistula which is caused by various medical or surgical procedures, it does occur extremely rarely, specifically in young patients. Diagnosing and treating ATEF is critical in ICU settings due to its dangerous hazards, which include aspiration repeated, respiratory distress, and ventilation and nutrition difficulty.

In this case report, we present a young girl who developed a high tracheoesophageal fistula after a protracted and difficult stay in the intensive care unit. Her medical history illustrates an intricate relationship between the need for life-saving measures and the danger of severe side effects due to long-term use. In her case, TEF most likely developed as a result of pressure necrosis of the tissue that stood between a nasogastric tube and an intratracheal tube, both of which were vital to her intensive care unit care.

The development of iatrogenic TEF caused by persistent pressure from medical devices forms an important, albeit rare, consequence in the ICU. The sensitive tissue between the trachea and esophagus may become permanently compressed when the intratracheal and nasogastric tubes lie close to each other. The pressure may eventually compromise the blood supply, leading to necrosis, ischemia, and then pathological fistula formation. Although these complications are rare, they do have a major impact on patient outcome since they usually present late and manifest as aspiration pneumonia, recurrent respiratory infections, and feeding difficulties.

This example highlights the importance of understanding the pathogenesis, risk factors, and preventive measures associated with iatrogenic TEF. Because critically ill patients often need long-term intensive care unit stays, mechanical ventilation, and enteral feeding through nasogastric tubes, it is important for healthcare professionals to be aware of potential problems and take preventive measures. Important steps to reduce the risk of such injuries include monitoring the placement of devices, selecting the appropriate size of the tube, and minimizing the time spent using the device.

In addition, TEF symptoms may mimic other problems related to ICU; hence, diagnosis can be challenging. Early detection is key to timely intervention, which is supported by imaging and

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endoscopic assessment. The complex needs of the patient, from stabilization to definitive repair, demand multidisciplinary care by intensivists, pulmonologists, surgeons, and nutritionists.

This adolescent girl's case provides a unique opportunity to reflect on the fine line that separates the advantages and disadvantages of life-saving measures. In critical care settings, it emphasizes the importance of alertness, early problem detection, and a proactive approach to patient safety. By shedding light on the processes, clinical manifestation, and treatment of iatrogenic TEF, this paper hopes to enhance future results for instances that are comparable.

2. LITERATURE REVIEW

Kattepura et al. (2024) talked about the uncommon incidence of acquired tracheoesophageal fistula (ATEF) in children, especially when they are on continuous mechanical ventilation. The authors described a 14-year-old girl who needed percutaneous gastrostomy feeding and was wheelchair-bound. The patient needed three weeks of invasive ventilation due to a history of cerebral dural venous sinus thrombosis (CVT), which caused paraplegia. She was unable to take oral meals for six months due to frequent lower respiratory infections, choking, and protracted coughing during feeding. A cervical TEF was discovered by imaging, and it was surgically closed using a sternocleidomastoid muscle flap. The patient's recuperation from the procedure went smoothly, and oral feeding was resumed. This example illustrates how pressure necrosis from the tracheostomy/endotracheal tube and the nasogastric feeding tube during continuous breathing can result in iatrogenic TEF.

Koumbourlis et al. (2020) examined how to treat tracheoesophageal fistula (TEF), a frequent congenital condition linked to esophageal atresia (EA). Due to the concomitant tracheomalacia, airway collapse, and poor secretion clearance, the study highlights the substantial respiratory morbidity that these disorders represent throughout life. The authors stress the value of noninvasive positive airway pressure support and surgical methods like tracheopexy to treat severe tracheomalacia, but they also suggest flexible bronchoscopy and imaging methods like CT scans for diagnosis. A multidisciplinary team's routine follow-up is essential to guaranteeing the greatest results for patients with this illness.

Khan et al. (2022) depicted an instance of a teen young lady who was first associated with having multisystem fiery disorder in kids (MIS-C) however later had (ARDS) during the

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Coronavirus pandemic. The patient experienced severe abdominal distension during respiration, which did not go away with nasogastric decompression, and the diagnosis was later changed to tuberculosis. A tracheoesophageal fistula (TEF) was diagnosed by bronchoscopy and oesophoscopy due to a high suspicion of a bronchoenteric fistula. This instance emphasizes how crucial it is to keep a close eye out for concurrent or alternative diagnoses while evaluating patients who exhibit complicated symptoms, especially in light of the COVID-19 pandemic.

Abdelaziz et al. (2023) examined how well Buerger Allen exercises affected wound healing and local circulation in kids who had lower extremity orthopedic surgery. The authors of a quasi-experimental investigation on 60 kids at Tanta Universal Teaching Hospital's Pediatric Surgical Orthopedic Department discovered that Buerger Allen exercises markedly enhanced epithelialization, granulation tissue production, wound color, and skin temperature. Additionally, the exercise improved wound healing, lowered peripheral edema, decreased capillary refill time, and improved ankle-brachial index scores. These results imply that Buerger Allen exercise helps children who have had surgery by increasing local circulation and hastening the healing of wounds.

3. CASE REPORT

A 14-year-old girl came with six-month history of recurrent lower respiratory tract infections and choking on food. A year back, a previous episode of CVT due to protein C and S deficit led to the development of these symptoms. The patient was on invasive ventilation for three weeks, being fed through a nasogastric tube as she had been having seizures and impaired sensorium. She had not taken solid or liquid food for six months before presentation due to fear of choking, which resulted in frequent episodes of coughing, flushing of the face, and acute fatigue. The patient's history of nasogastric tube feeding and extended invasive breathing made an acquired tracheoesophageal fistula (ATEF) a suspicion.

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Fig-1: Bilateral patchy infiltrates on the preoperative chest X-ray

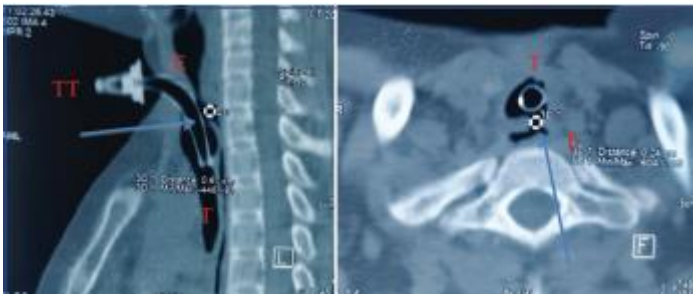

Fig-2: CT scan displaying TEF (arrow) in axial and sagittal views at the C7 and T1 junction

Fig-3: An intraoperative image demonstrating TEF cannulation using a ureteric catheter (UC)

Low-molecular-weight heparin was initiated and oral anticoagulants were discontinued in preparation for surgery. Chest physical therapy and antibiotics were initiated to optimize lung function. The trachea was inflamed, and a fistula 16.5 cm distal to the vocal cords was

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confirmed by rigid bronchoscopy. A ureteric catheter was placed into the esophagus via the fistula. A hockey stick incision on the left neck that crossed the tracheostomy scar down the sternocleidomastoid muscle led the dissection till discovery of the fistula that measured 1 cm and angling obtusely toward the esophagus. A superiorly based sternocleidomastoid muscle flap was then taken and positioned between the suture lines to seal after the trachea and esophagus had been sutured together by both absorbable and non-absorbable sutures.

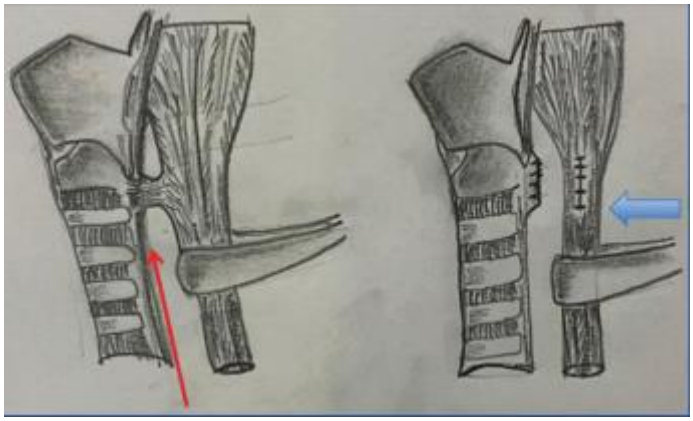

Fig-4: Diagrammatic representation of the oesophageal looping, TEF isolation, and closure.

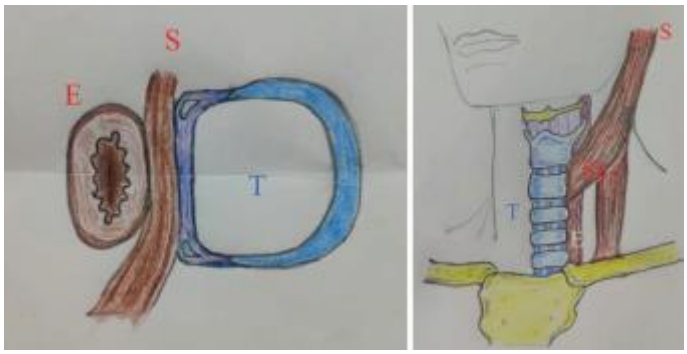

Fig-5: Diagrammatic representation of the sternocleidomastoid's sternal head positioned between the trachea and oesophagus.

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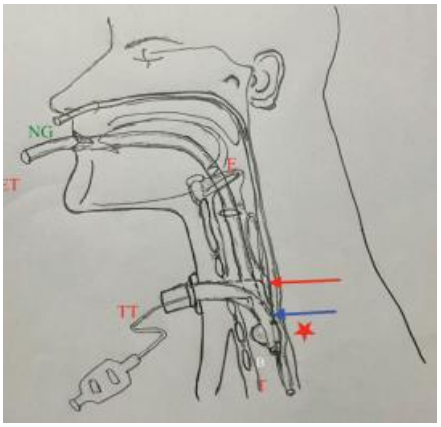

Fig-6: Diagrammatic representation of the tenable TEF explanation.

The patient's respiratory issues greatly improved after one day of elective ventilation following surgery. On the fifth postoperative day, oral feeding was initiated, and on the eighth day, she was discharged from the hospital. By the one-month mark, the patient's symptoms had completely disappeared, and an X-ray of the chest showed that the pneumonic patches and noticeable broncho-vascular marks had disappeared. A six months later, a follow-up chest X-ray showed a totally normal result, indicating that there was complete recovery along with successful closure of the fistula. This example puts forward how it might be challenging to diagnose and treat an acquired tracheoesophageal fistula, mainly in young patients with a complex medical history. Closure of the fistula using a sternocleidomastoid muscle flap and ensuring complete recovery is a possible outcome.

4. MATERIALS AND METHODS

4.1.Patient Selection and Case History

The study focuses on a teenage patient who was admitted to the hospital for specialist treatment following an acquired tracheoesophageal fistula (ATEF). Detailed medical information was obtained, including history, physical examination findings, and previous treatments. The patient had intratracheal and nasogastric tubes during his long-term intensive care unit admission at another hospital. Extensive evaluations were done to document risk factors, including the duration of intubation, the site of the nasogastric tube, and other conditions like infections and systemic problems.

4.2.Diagnostic Evaluations

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To validate the existence and features of ATEF, a comprehensive diagnostic workup was conducted.

1. **Imaging Studies**:
    - **Chest X-rays**: used to evaluate thoracic structural changes and detect pulmonary disease.
    - **CT scans**: carried out to assess lung involvement and pinpoint the precise location and size of the fistula.
2. **Endoscopic Assessments**:
    - **Bronchoscopy**: used to view the trachea, locate the site of the fistula, and assess damage to the mucosa.
    - **Upper Gastrointestinal Endoscopy**: carried out to assess the fistula's esophageal side and verify connection with the trachea.

In order to maintain continuity of care and prevent duplication, these diagnostic procedures were supplemented by a review of tests conducted at the referring healthcare provider.

4.3.Surgical and Postoperative Management

Given the severity of the patient's condition, surgical repair was the primary intervention.

1. **Surgical Procedure**:

To ensure that the tracheoesophageal fistula is permanently closed, a strong and well-vascularized sternocleidomastoid muscle flap was selected for the surgical procedure. The esophageal defect was closed transversely to ensure structural integrity and minimize the chance of recurrence, while the tracheal defect was closed vertically. The sternocleidomastoid muscle fold was put in the middle of between the stitch lines to upgrade recuperating and offer extra help.

2. **Postoperative Care**

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In order to identify any possible difficulties as soon as possible, postoperative treatment required careful monitoring of both gastrointestinal and respiratory systems. CT scans and other follow-up imaging were done to evaluate the healing process and verify that the fistula had closed successfully. These imaging tests yielded crucial data to guarantee the patient's healthy recovery and the lack of any postoperative problems.

5. RESULT

An acquired tracheoesophageal fistula (ATEF) in a teenage girl's clinical course revealed important information about the development, diagnosis, and treatment of this uncommon ailment. The patient was admitted to the Intensive Care Unit (ICU) after a lengthy and complex stay that involved the use of nasogastric and intratracheal tubes for nourishment and life support. Although these treatments were critical to her survival, she eventually developed a high-level tracheoesophageal fistula, most likely as a result of pressure necrosis. This underlines the challenges and risks of prolonged mechanical ventilation and nasogastric feeding in very ill pediatric patients.

Diagnostic tests confirmed the presence of ATEF. Imaging studies, which consisted of CT scans and chest X-rays, initially identified the location of the fistula as well as the evidence of lung injury. Before arriving at this medical facility, bronchoscopy and upper gastrointestinal endoscopy were done at another medical facility to know the nature of the fistula and the extent of tissue damage. These diagnostic modalities gave vital information for determining the location of the fistula, deciding the next course of treatment, and assessing the state of nearby structures.

The results showed that although iatrogenic tracheoesophageal fistulas (ITEF) are relatively rare in children, they do occur when nasogastric tubes are used for a long period and with considerable intracuff pressure. The pathogenesis most probably involved tracheitis at first, followed by mucosal ulceration and finally necrosis due to prolonged ischemia and pressure. These were further complicated by comorbid factors like recidivist infections, repeated tracheostomy tube exchanges, systemic conditions such as anemia, hypoxia, and metabolic acidosis, thus making ITEF creation in critical care more complicated.

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The patient's condition was treated based on her general poor health condition and that it limited the application of more conservative or less aggressive treatment options. Due to the ineffectiveness of conservative treatment in reducing the gravity of fistula, surgery had to be deemed necessary to manage the patient. Because of its proven capability to repair fistulas and strong vascular supply that will help in healing, the sternocleidomastoid muscle flap technique was chosen as the final therapy. This procedure was found to be suitable for high-level ATEF because it also reduced the possibility of recurrence and provided structural support.

Follow-up imaging showed that the fistula was closed adequately and that there were no acute issues during the closely observed postoperative recovery period. The fistula was appropriately treated by the sternocleidomastoid muscle flap; this lessened additional morbidity. The case highlights that ATEF care requires an individualized approach where patient stabilization is ensured and definitive surgery is considered when necessary.

6. DISCUSSION

Intrinsic TEF is notable in the pediatric age bunch, though procured TEF (ATEF) is more uncommon. There is no accessible epidemiological data in regards to ATEF. The essential drivers of ATEF in youngsters are ingestion of unfamiliar bodies and impaction. Iatrogenic TEF (ITEF) is very uncommon in youngsters. Sharp plastic articles, button batteries, pistachio nuts, and, surprisingly, in uncommon cases, tumors are a portion of the generally held up unfamiliar bodies that habitually cause ATEF. The most successive and perilous outsider articles end up being the button batteries. Pressure corruption of tissue between the bulbs of endotracheal or tracheostomy tube and the back counter-strain by taking care of nasogastric tube was most reasonable justification of ITEF in the patient. In very uncommon occasions, fistula might be caused because of the strain of the bed wounds at the knuckle of the backs calculated tube, or where the bended cylinder interacts with the counter-tension of nasogastric tube from behind Direct injury during the method of tracheostomy could be the component in the event that the level of the fistula is at the level of the stoma. There is banter about the specific reason for ITEF in the ongoing patient.

Prolonged intubation in the intensive care unit might result in pressure necrosis of the mucosa between a wide-bore nasogastric tube and a high intracuff pressure. The problem is made worse by frequent dressing changes for respiratory treatment and related infections through

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tracheostomy tubes. Another major contributing element in the development of ITEF is the duration of ventilation. Trachetis is the first event in the pathophysiology of injury, which is followed by ulceration and mucosal damage. The ITEF development also depends on other factors, including reduced blood supply to the mucosa due to hypotension, shock, anemia, hypoxemia, and metabolic acidosis in critical conditions. The nasogastric tube should be removed to prevent gastroesophageal reflux and to avoid a worsening of the fistula from pressure effects.

The balance between the pressure applied by the cuff and the mucosal perfusion pressure determines whether ischemic damage to the trachea occurs. It appears that tracheostomy has no effect on the frequency of fistula formation. ATEF usually arises in the trachea at a higher level than Congenital TEF (CTEF). A chest X-beam to assess lung harm is one of the indicative systems for problematic cases. For stable patients, an oesophogram can be proceeded as a difference study. The most useful analytic tests are oesophageal and bronchoscopy. These tests help in choosing the best careful arrangement. CT is a fundamental subsequent test after fix and furthermore helps in figuring out the area of the fistula and any related aspiratory injury. For this situation, the patient was alluded to the ongoing clinic after an upper GI endoscopy and CT filter was acted in another medical clinic.

Whether one should treat the ingestion of foreign bodies that causes ATEF is controversial. Case reports on a variety of therapeutic approaches have been documented. These include wait-and-watch, electrocautery, adhesive application, and surgical closure with or without the insertion of a vascularized muscle flap. Since this disease is rare and its clinical presentation is variable, there is no standardization of the treatment options. In the selection of the treatment plan, the patient's general health, the length and location of the fistula, the duration of symptoms, and any prior interventions should be considered. In fact, no published information exists that would suggest any treatment options for an ITEF. Four to eleven weeks of conservative care may be recommended based on the overall condition of the patient. If this fails, surgery should be done promptly. Many examinations suggest that mediation of lash muscles or sternomastoid muscle notwithstanding the upward conclusion of the windpipe and the cross over conclusion of the throat. The best way of treating ATEF is by surgical repair and not by less invasive techniques. For particularly significant problems, staged techniques are recommended.

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The general state of the index patient was poor, so authors did not use any of the less invasive, unproven techniques that may have unpredictable effects. Instead, a mighty and optimal sternocleidomastoid muscle flap was chosen because it was the most efficient way of occluding those fistulas.

7. CONCLUSION

The case report ends by citing the successful treatment of an acquired tracheoesophageal fistula in a teenage girl after nasogastric feeding and prolonged invasive ventilation. To manage the complicated fistula, maintain the integrity of the trachea and esophagus, and minimize the risk of recurrence, a sturdy and vascularized sternocleidomastoid muscle flap was chosen for surgical repair. Recovery from surgery was uneventful, and oral feeding could be resumed with improvement of respiratory symptoms. By the end of a month, symptoms had completely resolved, and subsequent imaging studies demonstrated closure of the fistula with normal lung function. This is an example that stresses how imperative it is to handle iatrogenic ATEF in critically ill young patients by ensuring early diagnosis, prompt surgical intervention, and adequate postoperative care.

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