Subcutaneous Emphysema and Pneumomediastinum after Eustachian Tube Balloon Dilation

Ravi R. Shah, MD\textsuperscript{1}, William W. Thomas, MD\textsuperscript{1}, James G. Naples, MD\textsuperscript{1}, and Michael J. Ruckenstein, MD, MSc\textsuperscript{1}

No sponsorships or competing interests have been disclosed for this article.

Keywords
eustachian tube, balloon dilation, subcutaneous emphysema, pneumomediastinum

Received November 30, 2017; revised March 1, 2018; accepted March 13, 2018.

Eustachian tube dysfunction (ETD) is caused by abnormalities of the eustachian tube and its ability to aerate the middle ear. Recent techniques to address ETD include eustachian tube balloon dilation (ETBD), laser, and microdebrider tuboplasty.\textsuperscript{1} ETBD is indicated after patients fail medical management, and it involves catheterizing the eustachian tubes with a balloon dilator. The procedure is often well tolerated with few complications. We report a case of subcutaneous emphysema and pneumomediastinum after ETBD.

Case Report

This report was exempted from review by the University of Pennsylvania Institutional Review Board.

Presentation

An otherwise healthy 28-year-old man presented with complaints of bilateral ear fullness and intolerance of barometric pressure changes for the last 4 years. Examination showed intact tympanic membranes without retraction or middle ear effusion. Audiometry showed normal hearing and type A tympanograms bilaterally. He was diagnosed with baro-induced ETD. Symptoms persisted despite 3 months of intranasal steroid spray use, and he elected to undergo bilateral ETBD.

Procedure

Under total intravenous general anesthesia, the patient was atraumatically intubated on first attempt with an 8.0-mm oral RAE tube under direct laryngoscopy, without mask ventilation. The nasal cavities were decongested. With a 30° endoscope, the tested 6 × 20-mm balloon dilation catheter (Entellus XprESS Ultra; Entellus Medical, Plymouth, Minnesota) was passed into the right eustachian tube. Bent to 45°, the catheter passed easily without resistance on first attempt. The tubal isthmus was dilated to 12 atmospheres for 2 minutes in accordance with the manufacturer’s instructions. The balloon was deflated and withdrawn, and the procedure was repeated on the left. No bleeding was observed following dilation. The patient was extubated awake without significant coughing or bucking. He was discharged home postoperatively.

Postoperative Course

On postoperative day 1, the patient reported sneezing vigorously while lifting 30 to 40 lb at work and subsequently developing bilateral facial and neck swelling. Before transfer to our institution, he received intravenous steroids at a local emergency department, without improvement. On arrival, he was afebrile with stable vital signs. Physical examination revealed crepitus of the head, neck, and upper chest, as well as intact tympanic membranes without middle ear fluid. Nasopharyngolaryngoscopy demonstrated normal mucosa of the nasopharynx, eustachian tubes, and larynx (see Supplemental Video S1, available in the online version of the article). Computed tomography demonstrated extensive subcutaneous emphysema in the head, neck, and chest, with significant pneumomediastinum (Figures 1 and 2). Sinus precautions were instituted (no nose blowing, lifting >5 lb, drinking through straws, coughing, or sneezing with mouth closed). Cardiothoracic surgery consult recommended observation. The patient’s subcutaneous emphysema improved over 48 hours without intervention, and he was discharged home.

Discussion

Although the device used in this case is Food and Drug Administration approved for ETD, the indications and utility of ETBD are still being established. Recent reviews showed passed into the right eustachian tube. Bent to 45°, the catheter passed easily without resistance on first attempt. The tubal isthmus was dilated to 12 atmospheres for 2 minutes in accordance with the manufacturer’s instructions. The balloon was deflated and withdrawn, and the procedure was repeated on the left. No bleeding was observed following dilation. The patient was extubated awake without significant coughing or bucking. He was discharged home postoperatively.

Postoperative Course

On postoperative day 1, the patient reported sneezing vigorously while lifting 30 to 40 lb at work and subsequently developing bilateral facial and neck swelling. Before transfer to our institution, he received intravenous steroids at a local emergency department, without improvement. On arrival, he was afebrile with stable vital signs. Physical examination revealed crepitus of the head, neck, and upper chest, as well as intact tympanic membranes without middle ear fluid. Nasopharyngolaryngoscopy demonstrated normal mucosa of the nasopharynx, eustachian tubes, and larynx (see Supplemental Video S1, available in the online version of the article). Computed tomography demonstrated extensive subcutaneous emphysema in the head, neck, and chest, with significant pneumomediastinum (Figures 1 and 2). Sinus precautions were instituted (no nose blowing, lifting >5 lb, drinking through straws, coughing, or sneezing with mouth closed). Cardiothoracic surgery consult recommended observation. The patient’s subcutaneous emphysema improved over 48 hours without intervention, and he was discharged home.

No sponsorships or competing interests have been disclosed for this article.

Keywords
eustachian tube, balloon dilation, subcutaneous emphysema, pneumomediastinum

Received November 30, 2017; revised March 1, 2018; accepted March 13, 2018.

Eustachian tube dysfunction (ETD) is caused by abnormalities of the eustachian tube and its ability to aerate the middle ear. Recent techniques to address ETD include eustachian tube balloon dilation (ETBD), laser, and microdebrider tuboplasty.\textsuperscript{1} ETBD is indicated after patients fail medical management, and it involves catheterizing the eustachian tubes with a balloon dilator. The procedure is often well tolerated with few complications. We report a case of subcutaneous emphysema and pneumomediastinum after ETBD.

Case Report

This report was exempted from review by the University of Pennsylvania Institutional Review Board.

Presentation

An otherwise healthy 28-year-old man presented with complaints of bilateral ear fullness and intolerance of barometric pressure changes for the last 4 years. Examination showed intact tympanic membranes without retraction or middle ear effusion. Audiometry showed normal hearing and type A tympanograms bilaterally. He was diagnosed with baro-induced ETD. Symptoms persisted despite 3 months of intranasal steroid spray use, and he elected to undergo bilateral ETBD.

Procedure

Under total intravenous general anesthesia, the patient was atraumatically intubated on first attempt with an 8.0-mm oral RAE tube under direct laryngoscopy, without mask ventilation. The nasal cavities were decongested. With a 30° endoscope, the tested 6 × 20-mm balloon dilation catheter (Entellus XprESS Ultra; Entellus Medical, Plymouth, Minnesota) was passed into the right eustachian tube. Bent to 45°, the catheter passed easily without resistance on first attempt. The tubal isthmus was dilated to 12 atmospheres for 2 minutes in accordance with the manufacturer’s instructions. The balloon was deflated and withdrawn, and the procedure was repeated on the left. No bleeding was observed following dilation. The patient was extubated awake without significant coughing or bucking. He was discharged home postoperatively.

Postoperative Course

On postoperative day 1, the patient reported sneezing vigorously while lifting 30 to 40 lb at work and subsequently developing bilateral facial and neck swelling. Before transfer to our institution, he received intravenous steroids at a local emergency department, without improvement. On arrival, he was afebrile with stable vital signs. Physical examination revealed crepitus of the head, neck, and upper chest, as well as intact tympanic membranes without middle ear fluid. Nasopharyngolaryngoscopy demonstrated normal mucosa of the nasopharynx, eustachian tubes, and larynx (see Supplemental Video S1, available in the online version of the article). Computed tomography demonstrated extensive subcutaneous emphysema in the head, neck, and chest, with significant pneumomediastinum (Figures 1 and 2). Sinus precautions were instituted (no nose blowing, lifting >5 lb, drinking through straws, coughing, or sneezing with mouth closed). Cardiothoracic surgery consult recommended observation. The patient’s subcutaneous emphysema improved over 48 hours without intervention, and he was discharged home.

Discussion

Although the device used in this case is Food and Drug Administration approved for ETD, the indications and utility of ETBD are still being established. Recent reviews showed passed into the right eustachian tube. Bent to 45°, the catheter passed easily without resistance on first attempt. The tubal isthmus was dilated to 12 atmospheres for 2 minutes in accordance with the manufacturer’s instructions. The balloon was deflated and withdrawn, and the procedure was repeated on the left. No bleeding was observed following dilation. The patient was extubated awake without significant coughing or bucking. He was discharged home postoperatively.

Postoperative Course

On postoperative day 1, the patient reported sneezing vigorously while lifting 30 to 40 lb at work and subsequently developing bilateral facial and neck swelling. Before transfer to our institution, he received intravenous steroids at a local emergency department, without improvement. On arrival, he was afebrile with stable vital signs. Physical examination revealed crepitus of the head, neck, and upper chest, as well as intact tympanic membranes without middle ear fluid. Nasopharyngolaryngoscopy demonstrated normal mucosa of the nasopharynx, eustachian tubes, and larynx (see Supplemental Video S1, available in the online version of the article). Computed tomography demonstrated extensive subcutaneous emphysema in the head, neck, and chest, with significant pneumomediastinum (Figures 1 and 2). Sinus precautions were instituted (no nose blowing, lifting >5 lb, drinking through straws, coughing, or sneezing with mouth closed). Cardiothoracic surgery consult recommended observation. The patient’s subcutaneous emphysema improved over 48 hours without intervention, and he was discharged home.

Discussion

Although the device used in this case is Food and Drug Administration approved for ETD, the indications and utility of ETBD are still being established. Recent reviews showed passed into the right eustachian tube. Bent to 45°, the catheter passed easily without resistance on first attempt. The tubal isthmus was dilated to 12 atmospheres for 2 minutes in accordance with the manufacturer’s instructions. The balloon was deflated and withdrawn, and the procedure was repeated on the left. No bleeding was observed following dilation. The patient was extubated awake without significant coughing or bucking. He was discharged home postoperatively.

Postoperative Course

On postoperative day 1, the patient reported sneezing vigorously while lifting 30 to 40 lb at work and subsequently developing bilateral facial and neck swelling. Before transfer to our institution, he received intravenous steroids at a local emergency department, without improvement. On arrival, he was afebrile with stable vital signs. Physical examination revealed crepitus of the head, neck, and upper chest, as well as intact tympanic membranes without middle ear fluid. Nasopharyngolaryngoscopy demonstrated normal mucosa of the nasopharynx, eustachian tubes, and larynx (see Supplemental Video S1, available in the online version of the article). Computed tomography demonstrated extensive subcutaneous emphysema in the head, neck, and chest, with significant pneumomediastinum (Figures 1 and 2). Sinus precautions were instituted (no nose blowing, lifting >5 lb, drinking through straws, coughing, or sneezing with mouth closed). Cardiothoracic surgery consult recommended observation. The patient’s subcutaneous emphysema improved over 48 hours without intervention, and he was discharged home.

Discussion

Although the device used in this case is Food and Drug Administration approved for ETD, the indications and utility of ETBD are still being established. Recent reviews showed
improvement in symptoms and reduced severity on ETD scoring; however, there is a lack of standardization to objectively measure outcomes.\textsuperscript{1,2} ETBD is relatively safe, with an estimated minor adverse event rate of 2\% and no reported cases of severe morbidity or mortality.\textsuperscript{1,2} Reported complications include self-limiting bleeding, rhinitis, mucosal crush injury, acute otitis media, and limited subcutaneous emphysema.\textsuperscript{1} The few reported cases of subcutaneous emphysema describe mild symptoms with air confined to the preauricular soft tissues, which in 1 case appeared on postoperative day 2 and resolved within 48 hours after discontinuing nasal saline irrigations and nose blowing.\textsuperscript{3,4} In our case, the emphysema was significant, tracking down to the chest and mediastinum, which to our knowledge has never been reported.

We theorize that the strain of heavy lifting combined with the increased pressure from sneezing caused barodissection at the sites of mucosal microtrauma within the eustachian tube, leading to accumulation of subcutaneous and retropharyngeal air. In this case, failure to comply with instructions to avoid exertion for at least 48 hours may be responsible for this complication. The continuity between the retropharyngeal and mediastinal spaces was the likely path of extension of air from the nasopharynx. Other possibilities include false passage of the balloon catheter (which was thought to be unlikely given passage of the catheter without resistance), oro- or hypopharyngeal injury during intubation, bleb rupture, or undetected tracheobronchial perforation from intubation (which is exceedingly rare).\textsuperscript{5}

Minor mucosal injury likely goes undetected in many cases and is ordinarily of little consequence. However, this case raises a question: Should standard ETBD postoperative instructions include sinus precautions for 48 to 72 hours postoperatively, while the instrumented mucosa heals? This rare but potentially serious complication warrants recognition prior to mainstream use of this new device as outcomes and complications continue to be clarified.

Author Contributions
Ravi R. Shah, conception, drafting, revising, final approval; William W. Thomas, acquisition and analysis of data (intraoperative), drafting, revising, final approval; James G. Naples, conception, drafting, revising, final approval; Michael J. Ruckenstein, conception, acquisition and analysis of data (intraoperative), revising, final approval.

Disclosures
Competing interests: None.
Sponsorships: None.
Funding source: None.

Supplemental Material
Additional supporting information is available in the online version of the article.
References


