



## Cervicofacial Emphysema After Routine Dental Procedures: An Iatrogenic Complication or Odontogenic Infection with Necrotizing Fasciitis?

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### Abstract

A number of both infectious and non-infectious etiologies may result in cervicofacial emphysema. Iatrogenic subcutaneous emphysema occurring after dental instrumentation is usually a benign and self-limited process. However, it remains critical to rule out ominous causes of cervicofacial emphysema, namely necrotizing fasciitis. Here, we discuss the case of an individual with a history of recent dental procedures presenting with clinical and radiologic findings concerning for necrotizing fasciitis. Subsequent neck exploration was unremarkable, indicating the preceding dental instrumentation as the likely iatrogenic source of his extensive cervical subcutaneous emphysema. Therefore, we also discuss strategies to help differentiate necrotizing fasciitis from other benign causes of cervical emphysema.

### Introduction

Cervicofacial emphysema, defined as the abnormal presence of air within the soft tissue of the head and neck, may result from a number of infectious and non-infectious etiologies. This abnormal introduction of air into soft tissues then propagates along interconnected fascial planes [1,2]. Known non-infectious causes include blunt trauma [3], airway foreign bodies [4,5], abdominal surgery [6,7], tracheal injury [8], and spontaneous rupture of terminal alveoli [9]; while infectious causes include odontogenic infection [10] and necrotizing fasciitis. Cervicofacial emphysema was first reported in 1900, when an individual developed remarkable cervicofacial swelling while playing the bugle after a dental extraction [11]. Since then, various dental interventions including dental extraction, endodontic treatment, and restorative dentistry have been associated with subcutaneous emphysema [1,2]. Historically, patient actions such as coughing, vomiting, or other valsalva maneuvers following dental extraction preceded cervicofacial emphysema. Presently, this complication commonly occurs after the use of sophisticated air-driven hand-pieces and high-speed drilling dental instruments [2,12].

With few exceptions, cervicofacial emphysema resulting from dental procedures is a relatively benign and self-limited process. Patients are often managed conservatively with rare need for surgical intervention [11]. In certain situations, the clinical presentation may be mistaken for the emergent condition of cervicofacial necrotizing fasciitis [NF]. NF is a rare, progressive infection with necrosis of soft tissue, subcutaneous fat and skin. NF has an incidence on 0.40 cases per 100,000 people [13]. Even much rarer, cervicofacial necrotizing fasciitis represents about 5% of NF cases and is usually caused by dental infection, oropharyngeal infection, and infection secondary to trauma [13,14].

A diagnostic conundrum exists in early NF since non specific clinical features such as erythema, tenderness, warm skin and swelling are present. Therefore, identifying the underlying cause of cervicofacial emphysema is central to appropriate and judicious management of these patients. Head and neck subcutaneous emphysema after dental procedures have been extensively discussed in the journals of dental medicine, while this complication has been rarely reported in otolaryngology literature despite its pertinence to the field [1]. Here, we present the case of a diabetic, ill-appearing 32-year-old male with cervicofacial emphysema of unclear etiology. At initial presentation, this was suspected to be an odontogenic infection after a dental extraction progressing to necrotizing fasciitis. We also discuss strategies to facilitate the critical differentiation of necrotizing fasciitis from benign causes of cervical emphysema.

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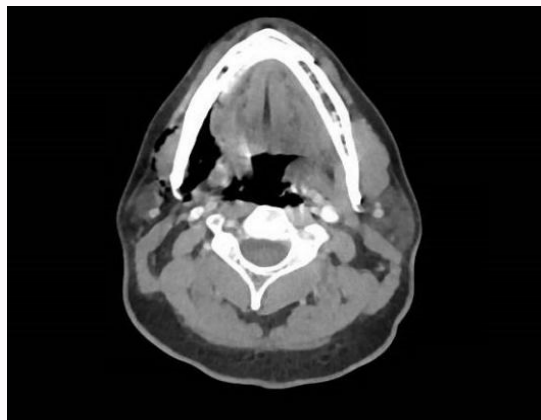
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**Figure 1:** Axial CT neck demonstrates subcutaneous emphysema around the right mandible and muscles of mastication.

## Case Presentation

A 32-year-old male with a recent history of a dental procedures, presented to the Emergency Department with complaint of right jaw pain, severe nausea with emesis and malaise. He had a history of right mandibular premolar tooth extraction without incidence two weeks ago prior to presentation and a routine dental cleaning on the day of presentation. His medical history was significant for type 2 diabetes mellitus. On evaluation, the patient's vital signs were as follows: afebrile with a temperature 36.6°C, tachycardia with heart rate of 108 beats per minute and hypertension with blood pressure of 140/91 mmHg. Abnormal blood tests include leukocytosis with white blood count of 21.1 k/cumm with 95% neutrophils and blood glucose level of 265 mg/dL. Physical examination was significant for right mandibular angle tenderness, tooth socket with fibrinous exudate and mild crepitus along right mandible; there was also mild erythema of anterior neck and supraclavicular area. A CT soft tissue neck demonstrated extensive cervical emphysema within the soft tissue of the neck centered on the right mandible and extending inferiorly to the mediastinum (Figures 1-3). No obvious fluid collections noted on imaging. Flexible fiberoptic laryngoscopy was unremarkable without any laryngeal edema or erythema.

The constellation of clinical findings was concerning for odontogenic infection with progression to cervicofacial necrotizing fasciitis. After the initiation of broad spectrum parenteral antibiotics with vancomycin and piperacillin/tazobactam, the patient was emergently taken to the operating room for a neck exploration and debridement. This neck exploration was negative for necrotic tissue or purulence along the deep fascial planes, with presence of healthy-appearing bleeding tissue noted. A wound swab was obtained from the neck as well as tooth socket. Normal flora was noted on the wound culture from the neck, while the culture from the tooth socket showed normal oral flora including moderate non-influenzae *Haemophilus* species. Since necrotizing fasciitis was eliminated, the patient's preceding dental cleaning on the day of presentation was surmised to be the likely cause of his cervicofacial emphysema and pneumomediastinum. It is suspected that a compressed air-driven instrument such as a tooth dryer may have been used during this dental cleaning. The patient had a four-day hospital stay, with normalization of his white blood cell count to 9.5 and transition to oral Augmentin at discharge. Cervical erythema and crepitus had resolved prior to discharge.



**Figure 2:** Axial CT neck shows subcutaneous emphysema surrounding the carotid sheath, cervical trachea, and dissecting the retropharyngeal/retroesophageal space.



**Figure 3:** Axial CT chest demonstrates pneumomediastinum with subcutaneous air around the intrathoracic trachea and esophagus.

## Discussion

Cervicofacial emphysema resulting from dental procedures represents a relatively benign and self-limited process. A variety of compressed air-driven hand-piece instruments used in dental interventions have been implicated, and have been used in different procedures ranging from endodontics, restorative procedures, crown preparation to dental extractions [1,2,12]. For instance, high-speed air turbine drills designed for cutting teeth are driven by compressed air at 3.5 to 4.0 Newton-meter, and can rotate at 450,000 revolutions per minute [15]. Air may be directed towards the burr to act as a coolant, which can result in the introduction of air at vulnerable sites. Similarly, a number of canal cleansing devices have been shown to generate positive apical pressures greater than of central venous pressure [16-19]. In most cases subcutaneous emphysema, patients can be conservatively managed with close observation and intravenous antibiotics [2,20,21]. Symptoms typically resolve within

several days with no long-term sequelae.

However, it is imperative to distinguish an iatrogenic complication from more ominous causes of cervicofacial emphysema, namely necrotizing fasciitis [NF]. Cervicofacial NF can occur from oropharyngeal or odontogenic infection, often in the setting of a predisposing systemic illness, commonly diabetes mellitus or immunodeficiency [14,22,23]. Clinical features of early NF such as pain, swelling and erythema of affected area are subtle, non-specific and easily confused with other skin and soft tissue infections [23,13,24]. Findings such as blistering, necrosis, and crepitus typically occur later in the disease process, and may still be present only in 10-40% of patients [13]. This may lead to missed or delayed diagnosis in the early stages of this disease. Lancerotto et al. [13] report that 85-100% of these patients may have missed or delayed diagnosis at presentation, which resulted in significantly worse outcomes with increased mortality rates. In their retrospective review, Wong et al. [25] found that only 13 out of 89 patients with confirmed necrotizing fasciitis were appropriately diagnosed at admission. The authors also noted that delay in surgery of greater than 24 hours correlated with significantly increased mortality rates ( $RR = 9.4$ ,  $p < 0.05$ ) [25]. Unsurprisingly, mortality is significantly decreased in patients with early aggressive surgical debridement when compared to delayed or incomplete surgical debridement (4.2% vs. 38%,  $p = 0.0007$ ) [26].

In order to facilitate accurate and prompt diagnosis of NF, several evaluation tests including imaging, a scoring system and bedside biopsy have been described [23,27]. Relevant findings on computed topography and magnetic resonance imaging are thickening and enhancement of the skin, subcutaneous tissue, fascia, and muscle [28], with lack of facial enhancement on contrast administration suggested to be of paramount diagnostic value [29,30]. The presence of air on imaging is variable, reported in 16.9% - 83% of patients, and may not be specific to necrotizing fasciitis [23,25,29]. In 2004, Wong et al. [30] proposed the Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) score, which uses serologic values to stratify patients into three risk groups: low, intermediate and high risk groups. LRINEC scores is estimated using: the serum levels of C-reactive protein, white blood count, creatinine, glucose, and sodium. ALRINEC score  $\geq 6$  carries a greater than 50% risk of NF, therefore NF must be carefully ruled out. Notably, the LRINEC score does not establish a definitive diagnosis and can be elevated in non-necrotizing severe soft tissue infections [31-34].

In an effort to prevent treatment delays, several adjunctive bedside procedures to facilitate diagnosis of NF have been described. Some authors report performing a small incision and wound exploration at bedside [35,36]. In NF, grossly necrotic tissue, absence of bleeding, fascial edema, and thin foul-smelling pus would be noted. Andreassen et al. [36] also suggest that minimal resistance with finger dissection of the deep cervical fascia can help confirm this diagnosis. Bedside tissue biopsy with frozen section analysis may also be beneficial [36-38]. In their case series of NF patient over 15 years, Majekski & Majekski used a bedside biopsy to accurately diagnosis NF in 12 of 43 patients, and NF was confirmed on subsequent surgical exploration; the remaining 31 patient had non-NF infectious process such as cellulitis or abscess [38]. Under local anesthesia with 1% lidocaine, the authors described obtaining an elliptical biopsy 2cm x 1cm of skin with underlying soft tissue & fascia of the affected area. This tissue biopsy is immediately taken for gram stain and frozen section, with their pathologist establishing a diagnosis of NF within 15 minutes of

receiving the specimen. However, surgical exploration remains the most sensitive and reliable diagnostic tool to confirm or exclude NF [13].

This case illustrates that cervicofacial emphysema can have a broad non-infectious differential. Subcutaneous emphysema can occur as an iatrogenic complication of dental procedures when air-driven hand-piece dental instruments are used. Non-infectious cervicofacial emphysema is often a self-limited process that improves with conservative management, but can be mistaken for early NF given nonspecific clinical features. In the case presented, the constellation of clinical findings coupled with the cervicofacial emphysema in this patient strongly suggested early necrotizing fasciitis from an odontogenic infection after a dental extraction: the patient had a systemic inflammatory response with chills, tachycardia, malaise, and was toxic-appearing, in addition to his poorly controlled diabetes mellitus conferring an immunocompromised state. The high clinical suspicion for necrotizing fasciitis warranted early surgical exploration in this patient, since clinical and radiology findings are often non-specific in early NF [13] and delay in surgical exploration is associated with increased risk of mortality in NF [23,25]. A serum C-reactive protein was not obtained and thus a LRINEC score could be calculated in this case. None the less, the authors concede that a limited bedside biopsy could have been used as an intermediate procedure to further guide clinical decision making. A “watch and wait” approach with parenteral antibiotics is potentially risky if NF is suspected given high mortality rates, ranging from 19-40%. When presentation is equivocal, consider the use of adjunctive bedside procedures such as incision with wound exploration or tissue biopsy with frozen section analysis, to help confirm or exclude the diagnosis of necrotizing fasciitis.

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