Iatrogenic Subcutaneous Emphysema of Dental and Surgical Origin: A Literature Review

Wm. Stuart McKenzie, BM, and Morton Rosenberg, DMD†*

Purpose: Subcutaneous emphysema arises when air is forced beneath the tissue, leading to swelling, crepitus on palpation, and potential to spread along the fascial planes. The goal of this literature review is to alert the oral and maxillofacial surgeon to the inciting factors, diagnosis, and management of subcutaneous emphysema.

Patients and Methods: A comprehensive search of the medical and dental literature from 1993 to 2008 was performed using PubMed, and yielded 32 case reports of subcutaneous emphysema. Only cases associated with dental or surgical procedures were included. Cases of trauma were excluded.

Results: Sixteen of the 32 cases were linked to the use of air-driven handpieces. Other cases involved a CO_2 laser, a NO_2 cryomachine, an air abrasive system, endotracheal intubation/ventilation, and patient activities after surgical procedures. Of the cases reviewed, 5 resulted in significant complications after subcutaneous emphysema.

Conclusion: Although rare, iatrogenic subcutaneous emphysema can have serious and potentially life-threatening effects. Care should be taken when using air-driven handpieces or performing endotracheal intubation/ventilation. Additionally, instructions should be given to patients after procedures violating the epithelium to reduce the incidence of subcutaneous emphysema. When subcutaneous emphysema does arise, it must be quickly diagnosed and properly managed to reduce further complications.

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Subcutaneous emphysema is a rare but serious side effect of dental and oral surgery procedures. The condition is characterized by air being forced underneath the tissue, leading to swelling, crepitus on palpation, and with potential to spread along the fascial planes to the periorbital, mediastinal, pericardial, and/or thoracic spaces. A wide range of causes have been documented for the origin of subcutaneous emphysema during dental treatment including: crown preparations, other operative procedures, endodontic therapy, extractions, as well as oral surgery procedures. The use of air-driven handpieces appears to be related in the majority of the case reports; however, events in the perioperative period including endotracheal intubation and positive pressure ventilation have also been reported in association with subcutaneous emphysema. Because of the many recent case reports of subcutaneous emphysema and air emboli during dental procedures, the goal of this review is to alert the oral and maxillofacial surgeon to the origin, presentation, diagnosis, management, and treatment of iatrogenic subcutaneous emphysema.

Patients and Methods

A comprehensive search of the medical and dental literature was performed via PubMed using the keywords "subcutaneous emphysema" with the limits of English and dental journals. "Emphysema AND dental," "emphysema AND oral surgery," and "emphysema AND orthognathic surgery" were also searched. A retrospective study published in 1995 by Heyman and Babay reviewed 74 reports of subcutaneous emphysema from 1960 to 1993. As a continuation of the Heyman compilation, it was decided to focus on reports from 1993 (not included in the Heyman article) to 2008. Cases solely due to trauma were excluded. From the PubMed

Received from Tufts University School of Dental Medicine, Boston, MA.

*Third-Year Dental Student.

†Professor, Oral and Maxillofacial Surgery, and Head of the Division of Anesthesia and Pain Control.

Address correspondence and reprint request to Dr Rosenberg: Department of Oral and Maxillofacial Surgery, Tufts University School of Dental Medicine, One Kneeland Street, Boston, MA 02111; e-mail: morton.rosenberg@tufts.edu

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Table 1. REPORTED CASES OF SUBCUTANEOUS EMPHYSEMA FROM 1993 TO 2008

Reference	Gender/Age	Tooth	Procedure	Suspected Cause	Distribution	Antibiotics	Complications
3	M 47	R mand second molar	Extraction	HS	SC, PM	+	Focal alveolitis
17	F 52	L mand first premolar	Class V restoration	HS	SC	+	—
5	F 43	4 maxillary teeth	Apicoectomy w/GA	Intubation + vomiting	SC, PM, PT	—	Exploratory surgery, ventilation
2	F 19	R max central incisor	Abscess removal	CO_2 laser	SC, orbit	+	—
18	F 29	Mandibular teeth	Not described	HS	SC, PM, RPx	+	—
19	F 43	L max second premolar	Restoration	HS	SC, PM, orbit, RPx	+	—
20	F 24	R mand third molar	Extraction	HS	SC, PM, orbit	+	—
	F 26	L mand third molar	Extraction	HS	SC, PM, RPx	+	—
3	F 62	Mandibular trigeminal neuralgia	GA, IAN cryoblockade	Coughing or NO_2 cryomachine	SC, orbit	—	Collet-Sicard syndrome
21	F 25	L mand first molar	RCT	Air syringe	SC, RPx, PM	+	—
6	M 37	Not described	GA/extractions	Self extubation	SC, orbit, PT	+	Collapsed left lung
22	M 45	L mand third molar	Extraction	HS	SC, orbit, RPx, bilateral PM, PT	+	—
23	F 14	R and L mand third molars	Extraction	HS	SC, axilla, PM	—	—
24	M 23	L mand second molar and second premolar	Crown prep	HS, existing cheek bite	SC, orbit	+	—
4	F 16	L max second molar	Fissure debridement	Air abrasive system	SC, orbit, PM	—	—
9	F 37	None	Orthognathic surgery	Blowing nose	SC, orbit	—	—
25	F 35	L mand second molar	RCT	HS	SC, orbit	+	—
26	M 42	R mand second molar	Overhang removal	Slow speed, A/W syringe	SC, orbit, PM	+	—
14	F 32	R max first and third molars	Restoration	Iatrogenic laceration during prep	SC, orbit	+, low-dose steroids	TMJ clicking
27	M 64	R mand third molar	Extraction	HS	SC	—	—
28	F 39	L mand first and second molar	RCT	Air syringe	SC, cervical emphysema	+	—
29	F 50	L mand second molar	Crown prep	HS	SC, PM, orbit	+	—
15	F 36	L mand first premolar and molar	Crown prep	HS	SC, orbit, PM	+, Decadron	—
30	M 47	R mand first and second premolars	Class V restoration	HS, A/W syringe	SC, orbit	—	—
31	F 5	L mand primary second molar	Occlusal restoration	HS	SC, PM	+	—
16	M 21	All third molars	Extraction	HS	SC, orbit, PT, PM, PP	—	Air emboli, seizures, memory deficit
8	M 19	None	Le Fort I, BSSO, genioplasty	Excessive ventilation pressure	SC, PM	—	—
32	M 7	Not specified	Extraction, RCT, restorations	Not specified	SC, orbit	+	—
33	F 47	Not specified	RCT	Not specified	SC, prevertebral space	—	—
10	F 58	Not specified	Mental nerve transposition, implant, GA	Blowing into peak flow meter	SC	+	Sinus tract under chin
7	M 18	None	Preop intubation	Laryngeal/tracheal laceration, excessive ventilation pressure	SC, bilateral PT	—	Emergency tracheotomy, bilateral chest tubes
1	M 25	L mand first molar	Crown prep w/impression	Not specified	SC, orbit, RPx, PM	—	—

Abbreviations: SC, subcutaneous; PM, pneumomediastinum; PT, pneumothorax; RPx, retropharynx; GA, general anesthesia; HS, high-speed handpiece; IAN, inferior alveolar nerve; RCT, root canal therapy; BSSO, bilateral sagittal split osteotomy; R, right; L, left; Mand, mandibular; Max, maxillary.

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search, 32 case reports were found to adhere to our inclusion criteria (Table 1).

Results

Sixteen of the 32 cases reported involved an air-driven handpiece. In a previous literature review, the dental handpiece also constituted the majority of subcutaneous emphysema reports.[1] As seen in Table 1, the use of air-driven handpieces during restorative procedures, extractions, crown preps, and endodontic therapy are involved in the greatest number of emphysematous complications. Other more recent reports appear to include a CO_2 laser, a NO_2 cryomachine, and an air abrasive system.[2-4] Of the cases involving general anesthesia and endotracheal intuba-

tion, 4 involved significant damage to the tracheal mucosa during intubation/extubation or ventilation at high pressure and volume. Patient monitoring and suspicion for subcutaneous emphysema should be raised when any mucosal laceration is encountered during intubation and ventilation.[5-8] The other 3 cases of emphysema after general anesthesia were because of violent coughing by the patient, patient blowing his/her nose, or blowing into a peak flowmeter.[3,9,10] Although this review is limited to subcutaneous emphysema of dental or surgical origin, it should be noted that reports of self-induced emphysema have also been reported.[11,12]

Discussion

Subcutaneous emphysema can be a serious complication of dental or surgical therapy. Although subcutaneous emphysema rarely causes long-term morbidity, the early recognition and proper management is critical to prevent progression. Subcutaneous emphysema arises when air is forced, under pressure, into the fascial spaces of the tissue. Once the air is under the tissue, dissection can occur along the relatively delicate connective tissue joining adjacent muscle planes. Communication of the fascial spaces allows for air introduced from the mandibular region to spread to the retropharynx, mediastinal, pericardial, or thoracic spaces. Subcutaneous emphysema can also be induced by the patient coughing, blowing forcefully, smoking, or vomiting after a dental procedure. During procedures requiring anesthesia, tearing of the tracheal mucosa during intubation or increased pressure in the alveoli because of excessive ventilation pressure can lead to introduction of air into the pleural and mediastinal spaces.

The presenting signs and symptoms of subcutaneous emphysema after a procedure vary. Whereas some reports note almost immediate signs of swelling, other cases took minutes to hours after the procedure was completed before the patient became symptomatic. Patients with subcutaneous emphysema show marked swelling and discomfort where air has penetrated subcutaneous tissue, and respiratory alterations if the subcutaneous emphysema has spread to the paratracheal, mediastinal, or thoracic spaces. The pathognomonic sign of subcutaneous emphysema is crepitus on palpation, which allows one to quickly rule out anaphylactic reactions or angioedema in cases of acute swelling. In patients with pneumomediastinum, a friction rub may be heard during systole on cardiac auscultation (known as Hamman's sign). Emphysema of the pericardial space may result in alterations to the EKG such as, inverted T wave, ST segment elevation, decreased voltage, and shifts in the electrical axis.[7] A radiographic examination of the patient should be conducted as soon as subcutaneous emphysema is detected to determine the extent and location of the emphysema. Patients with clinically significant subcutaneous emphysema should be monitored closely prior to discharge for respiratory or cardiac distress. Most cases of subcutaneous emphysema, although alarming, usually resolve spontaneously in 3 to 5 days with no complications or morbidity, and complete recovery in 7 to 10 days.

Clinicians should follow the manufacturer's recommendations as to the proper use and maintenance of the air-driven turbine to prevent subcutaneous emphysema. Additionally, postoperative instructions after a dental or surgical procedure should include avoidance of coughing, smoking, blowing the nose, using straws, vomiting, or any other activity that may increase pressure in the oral cavity. When endotracheal intubation is required, excessive inspiratory pressures and volumes should be avoided, and care should be taken to decrease injury to the tracheal mucosa.

Among the series we report, 20 of the 32 patients received antibiotics after diagnosis of subcutaneous emphysema. The rationale for antibiotics is that air introduced from an intraoral site is likely to carry with it bacteria that could potentially lead to rapidly spreading cellulitis or necrotizing fasciitis. As seen in Table 1, after an episode of subcutaneous emphysema and antibiotic therapy, there was 1 report in which focal alveolitis developed, and a second report of a sinus tract under the chin.[10,13] No other complications because of spread of infection after subcutaneous emphysema were noted. A few cases reported the use of low dose steroids (dexamethasone) for subcutaneous emphysema.[14,15] As with the antibiotic therapy, it is difficult to determine whether the use of steroids has any benefit in the treatment of subcutaneous emphysema. Consensus on antibiotic therapy and corticosteroid administration after subcutaneous emphysema is unclear.

Rarely is surgical intervention necessary after diagnosis of subcutaneous emphysema. In isolated cases the need for exploratory surgery, the need for emergency tracheotomy, and the need for placement of chest tubes have been reported.[5,7]

An unusual consequence of subcutaneous emphysema reported by Willy resulted in Collet-Sicard syndrome, which is characterized by a palsy of cranial nerves IX through XII. In this report, a 62-year-old female underwent a cryoblockade procedure of the inferior alveolar nerve, and developed emphysema during immediate postoperative recovery. The suspected mechanism was compression of the carotid sheath at the level of the jugular foramen, which may have caused damage to the cranial nerves. Two months later the glossopharyngeal and vagus nerve

had fully recovered, and at 4 months the patient had regained full function of the hypoglossal and spinal accessory nerves.[3]

In addition to the development of subcutaneous emphysema during oral surgery procedures, another possible iatrogenic complication is the introduction of air into the circulatory system. This very rare occurrence has been reported by Magni, and further emphasizes the need for caution when performing oral surgery. The report describes a 21-year-old male scheduled for the removal of impacted third molars under general anesthesia. Forty-five minutes postop, the patient showed signs of subcutaneous emphysema. One hour later, the patient lost consciousness and began having seizures. Magnetic resonance imaging showed ischemic lesions in the brain because of air emboli in the circulation, ultimately leading to moderate short-term memory impairment. These complications show the potential for serious morbidity because of subcutaneous emphysema.

In conclusion, subcutaneous emphysema is a potential complication of procedures that interrupt the epithelium of the oral cavity and introduces air, under pressure, along or into the fascial spaces of the head and neck. Although the frequency is rare, iatrogenic subcutaneous emphysema can have serious and potentially life-threatening effects. When subcutaneous emphysema does arise, it must be quickly diagnosed, understood, and effectively managed to reduce the incidence of further complications.

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