

The Dangers of Sneezing: A Review of Injuries

American Journal of Rhinology & Allergy

2019, Vol. 33(3) 331–337

© The Author(s) 2019

Article reuse guidelines:

sagepub.com/journals-permissions

DOI: 10.1177/1945892418823147

journals.sagepub.com/home/ajr

**Sean Setzen¹ and Michael Platt, MD, MSc¹**

Abstract

Background: Sneezing is an almost universal daily phenomenon as a reflex to evacuate irritants from the nasal cavities. An autonomic-controlled buildup of intrathoracic pressure against a closed glottis followed by sudden release results in a burst of 1 kPa of air through the upper airway. Active intervention to limit a sneeze can be deleterious. Closure of the airway during a sneeze can result in over 20 times the airway pressures resulting in a variety of untoward events. This review summarizes all reported injuries that occurred as the result of a sneeze.

Objective: The objective of this review is to summarize the risks of closed-airway sneezing and determine if there are any trends which can help understand such injuries.

Methods: A comprehensive literature review was performed from 1948 to 2018 to identify all reports of sneeze-related injuries. Information was compiled from reports to gain insights into comorbidities and risk factors for sneeze injuries.

Results: There were 52 unique reports of sneeze-related injuries in the literature that were categorized into 6 areas of injury: intrathoracic, laryngeal/pharyngeal, ocular/orbital, intracranial/neurological, otologic, and other. The mean age of subjects who suffered a sneeze injury was 40 years old (range: 15–84 years), with 81% being male gender. Thirty percent had a risk factor for injury of prior trauma (5) or respiratory compromise (5).

Conclusion: A variety of injuries can occur during a sneeze, especially when a closed-airway sneeze is attempted, and high Valsalva pressure is transmitted to the other systems. Men are more at risk for these injuries with the majority occurring in patients with no known risk factor. When triggered, a sneeze should be allowed to proceed without intervention to prevent associated injuries.

Keywords

sneeze, sneezing, injury, Valsalva, airway, trauma

Introduction

Sneezing is a universal, involuntary human nerve reflex function that can be caused by a number of local irritants, chronic inflammatory diseases, and other stimuli. Intranasal triggers that induce a sneeze can include mucus, infectious pathogens, dust, allergens, or particulate/chemical irritants. These foreign substances can cause local irritation, stimulation of the trigeminal system, or prevent laminar airflow resulting in a trigger to sneeze.

Once the sneeze has been triggered, release of the neurotransmitter histamine sends a signal from the trigeminal nerve to the brainstem causing a coordinated deep inspiration with pressure built-up against a closed glottis.¹ Coordinated opening of the glottis with contraction of thoracic musculature releases the pressure through the

upper airway. A simultaneous elevation of the tongue forces air out of the nose at speeds close to 30 m/s.²

The closed-airway sneeze results from a voluntary effort to suppress the sneeze and limit the audible rush of air through the nasal cavities. Active closure of both the oral cavity and nasopharynx results in airway pressures close to 20 times the normal sneeze.² Transmission of pressures to other parts of the body results in the potential for a variety of injuries. Although these injuries are rare and presented in the literature as individual case

¹Department of Otolaryngology – Head and Neck Surgery, Boston University School of Medicine, Boston, Massachusetts

Corresponding Author:

Michael Platt, 830 Harrison Ave, FGH 4, Boston, MA 02446, USA.

Email: miplatt@bu.edu

reports, there has been no systematic review of sneeze injuries. This study compiles all data from sneeze injuries to help understand the risk factors and nature of sneeze injuries.

Methods

A comprehensive literature search was performed using PubMed and ResearchGate databases from 1945 to July 9, 2018. Identification of all reports of sneeze-related injuries was performed using the following keyword searches: sneeze injury, sneeze related injury, sneeze caused injury, sneeze after surgery, sneeze pain, sneeze trauma, sneeze retinal, sneeze fracture, sneeze laryngeal fracture, sneeze orbit, sneeze pneumothorax, sneeze intercostal, sneeze aortic dissection, sneeze pneumomediastinum, sneeze spontaneous, sneeze and hernia, and sneeze orbital emphysema. All identified references were reviewed for details relating to the clinical scenario. Demographic information, details of the injury, and outcomes were compiled. Descriptive statistics were analyzed to identify trends in injuries.

Results

There were 52 unique reports of sneeze-related injuries in the literature since 1945 (Table 1). The mean age of subjects who suffered a sneeze injury was 40 years old (range: 15–84 years). Of the 47 cases that reported the gender of the patient, 81% (38) were male and 19% (9) were female (Table 2). Comorbid conditions included hypertension, obesity, asthma, cigarette smoking, previous facial or ocular trauma, and respiratory tract infections. Those 10 patients with prior trauma (5) or respiratory infections (5) were thought to have factors at the site of airway injury that predisposed them to barotrauma during Valsalva. The majority of cases (65%) did not have an identifiable risk factor for injury.

The sites of injury were classified according to anatomical location: ocular/orbital^{3–15} (27%), intrathoracic^{16–28} (25%), intracranial/neurological^{29–38} (19%), laryngeal/pharyngeal^{39–45} (13%), otologic^{46–48} (6%), and other^{49–53} (10%) (Figure 1). There were 15 cases orbital/ocular injury: orbital subcutaneous emphysema^{3–7,10,11,13–15} (10), orbital blow-out fracture^{9,13} (2), retrobulbar hematoma¹² (1), trochlear nerve paresis⁸ (1), and decreased retinal artery perfusion⁸ (1). Of these cases, 29% had prior facial trauma and the remainder did not have a known risk factor for orbital injury.

Cases of intrathoracic injury precipitated by a sneeze included pneumomediastinum^{18,20,22,26} (4), rib fracture^{24,28} (2), diaphragmatic tear^{24,25} (2), thoracic lung herniation^{16,21} (2), pneumothorax¹⁹ (1), basal pleural effusion²³ (1), and cervico-mediastinal hematoma²⁷ (1). Forty-six percent of thoracic injuries occurred in

patients who had a known lung disorder, and 82% of thoracic injuries were reported in male patients.

There were 7 cases reported of laryngeal/pharyngeal trauma which included laryngeal cartilage fracture^{39,43} (2), piriform sinus perforation⁴² (1), vocal fold hematoma^{40,44,45} (3), and retropharyngeal hemorrhage⁴¹ (1). All of these case reports were for male patients aged 30 to 45 years.

There were 10 cases of intracranial/neurological injury after sneezing which included pneumocephalus³⁸ (1), cerebral venous thrombosis^{30,33} (2), vertebral TIA³⁵ (1), migraine trigger^{29,36} (2), transient ischemic attack³² (1), spinal epidural hematoma^{34,37} (2), and upper cervical infarction³¹ (1). Sixty percent of these cases were in male patients.

There were 3 otologic cases identified in the literature. One patient experienced sudden sensorineural hearing loss,⁴⁸ 1 patient developed a perilymphatic fistula of the round window,⁴⁶ and 1 case described a patient who developed vertigo and headache.⁴⁷ Other injuries included aortic dissection^{49,53} (2), acute myocardial infarction⁵² (1), subcutaneous emphysema over the frontal sinus,⁵⁰ and dental implant displacement into the maxillary sinus.⁵¹

Discussion

Sneeze injuries are rare events but can be life-threatening. An exact calculation of the incidence and risk factors of sneeze injury is not possible due the very rare occurrence, resulting in case reports to better understand the phenomenon. This review identified 52 unique cases of sneeze injury that were seen in multiple organ systems. Transmission of Valsalva pressure during a sneeze has resulted in intracranial, intrathoracic, ocular, laryngeal, otologic, and vascular complications. The majority of cases occurred in patients who did not have a known risk factor for injury related to the sneeze, whereas 30% did have risk factors which included facial trauma, lung disease, and cardiac comorbidities.

Boyle's law states the inverse relationship between pressure and volume. During a sneeze, the high volume in the lungs against a closed glottis translates to high pressure as the glottis opens. However, many people do not like sneezing in public, whether due to the disruptive noise, perception of illness, or mere habit. While attempting to hold in a sneeze, the intrathoracic pressure gradient does not simply vanish. The pressure is rerouted or transmitted to the soft tissues resulting in a Valsalva maneuver with potential for many of the injuries and complications seen in this review.

The normal amount of pressure generated during the production of a sneeze is very large. On average, the pressure generated in the nasal airway by a sneeze is about 1 kPa (<1200 Pa).² However, when holding

Table 1. Cases of Sneeze Injuries (1945–2018).

Category	Citation	Injury	Gender	Age	Comorbidity
Intrathoracic	Karangizi et al. ²⁵	Diaphragmatic and intercostal muscle tear	M	69	Concurrent lower respiratory tract infection
	Mitsakos et al. ²⁸	Fractures to the sternum and ribs	M	26	
	Jüch et al. ²⁴	Fractured rib, diaphragmatic rupture, and chest wall hernia	M	72	Respiratory infection
	Bhardwaj et al. ¹⁶	Thoracic lung herniation	M	63	Obesity, 40-year smoking history, and hypertension
	Bourne ¹⁷	Asymptomatic bilateral spontaneous pneumothorax	M	15	
	Tewfik et al. ¹⁸	Pneumomediastinum and cervicofacial emphysema	NA	NA	
	Turner and Benton ¹⁹	Crepitus, interstitial emphysema, and pneumocephalus without pneumothorax	NA	33	Upper respiratory tract infection
	Dechambre et al. ²²	Pneumomediastinum	M	35	Smoking history and upper respiratory tract infection
	Law et al. ²⁶	Bilateral cervical subcutaneous emphysema spreading to supraclavicular fossae and pneumomediastinum	M	20	Chronic rhinitis
	Souza et al. ²⁰	Pneumomediastinum	M	37	
	García-Tirado et al. ²³	Bilateral basal pleural effusion and left latero-cervical-supraclavicular collection extending to all mediastinal compartments	F	60	Hypertension, dyslipidemia, and hypothyroidism
	Macdonald and Kelly ²⁷	Cervico-mediastinal hematoma	F	58	
	Brock and Heitmiller ²¹	Thoracic lung hernia	M	44	Obese and smoking history
Laryngeal/ Pharyngeal	Quinlan ⁴³	Thyroid cartilage fracture	M	44	—
	Morvan et al. ⁴²	Perforated piriform sinus	M	30	—
	Faden et al. ³⁹	Laryngeal fracture	M	38	
	Reuther and Weissbrod ⁴⁴	Hematoma of the left true vocal fold and laryngeal surface of the epiglottis	M	30s	
	Forner et al. ⁴⁰	Laryngeal injury and subcutaneous emphysema right vocal cord hematoma extending into the immediate anterior subglottis	M	33	
	Santamaría et al. ⁴⁵	Left vocal fold hematoma and left complete and nondisplaced parasagittal fracture of thyroid cartilage	M	36	
	Genovesi and Simmons ⁴¹	Spontaneous retropharyngeal hemorrhage	M	NA	Polycythemia vera and taking anticoagulants
Ocular/Orbital	Gauguet et al. ¹²	Orbital wall fracture, herniation of orbital fat, and orbital emphysema	M	15	Ocular trauma—right medial orbital wall fracture
	Akyol et al. ⁸	Blow-out orbital fracture	M	32	
	Roselle and Herman ⁵	Acute orbital swelling and crepitus	F	84	
	Khader and Abdul-Baqi ¹³	Ecchymosis of the right eye, pressure in the right orbit, and periorbital swelling	M	38	
	Koçak et al. ¹⁴	Unilateral orbital emphysema	M	30	Minor orbital trauma 2 days earlier that required no medical care
	Chiu et al. ¹⁰	Orbital subcutaneous emphysema	M	Middle-aged	

(continued)

Table 1. Continued.

Category	Citation	Injury	Gender	Age	Comorbidity
Intracranial/ Neurological	Reeves et al. ¹⁵	Subcutaneous emphysema	M	19	Blow-out fracture—ocular trauma
	Andreoli et al. ⁴	Trochlear nerve paresis	M	32	Craniotomy for aneurysm 6 months prior
		Transient decreased perfusion to right central retinal artery and afferent papillary defect	M	52	
	Deveer et al. ¹¹	Retrobulbar hematoma	F	31	
	Sen and Chaturvedi ⁶	Orbital emphysema	M	39	
	Ababneh ³	Orbital, subconjunctival, and subcutaneous emphysema	M	16	Blunt trauma to left orbit hours before the sneezing episode
	Yilmaz et al. ⁷	Blow-out fracture of right orbital floor which led to orbital emphysema and herniation of the orbital soft tissue	M	18	
	Birkent et al. ⁹	Orbital emphysema and pneumocephalus	NA	NA	
	Yun-xu et al. ³⁸	Diffuse pneumocephalus	M	26	Brain trauma
	Stokes et al. ³⁵	Dizziness, double-vision, headache, muscle weakness, and ataxia	M	35	
	Rottger et al. ³³	Instantaneous headache that lead to cerebral venous thrombosis	F	18	Oral contraceptives
	Fonseca et al. ³⁰	Cerebral venous thrombosis	F	41	Oral contraceptives
	Štětkářová et al. ³⁴	Lower thoracic and back pain, urinary retention, and severe paraparesis	F	64	Hypertension, aspirin
	Wu et al. ³⁷	Spinal epidural hematoma	M	24	
	van Oosterhout and Haan ³⁶	Migraines without aura	M	28	
Otolgic	Álvarez et al. ²⁹	Heminasal pain attacks with typical migraine features	NA	NA	
	Harrison ³²	Transient ischaemic attacks—50% stenosis on the left and 90% stenosis on the right	M	50	Facial palsy recorded during previous week
	Gutowski et al. ³¹	Upper cervical infarction in the region supplied by the left posterior spinal artery	M	35	History of cigarette smoking
	Whitehead ⁴⁸	Sudden sensorineural hearing loss with fracture of the stapes footplate	NA	NA	
	Comacchio and Mion ⁴⁶	Perilymphatic fistula of the round window	F	52	
Other	Garry and Forrest-Hay ⁴⁷	Headache and vertigo	M	32	History of neck trauma
	Hirsch et al. ⁵⁰	Subcutaneous emphysema	M	18	Acute frontal sinusitis
	Procacci et al. ⁵¹	Discharged a dental implant	F	63	
	Baydin et al. ⁴⁹	Aortic dissection	M	51	Hypertension
	Therrien et al. ⁵²	Acute myocardial infarction	M	34	Asthma, nasal polyposis, high cholesterol, and cigarette smoking
	Upadhyaya and Large ⁵³	Type B thoracic aortic dissection	M	57	Asthma and gout

Abbreviations: F, female; M, male; NA, not available.

in a sneeze, that pressure can be magnified from anywhere between 5 and even 24 times that of a normal sneeze.^{2,54} This review identified that the majority of cases of sneeze injury were seen in men. The increased lung volume in men⁵⁵ and subsequent increased pressure can explain why men are more at risk for sneeze injuries.

The amount of pressure exuded on the different parts of the body during a suppressed sneeze can greatly vary based on whether the nose alone is blocked, the mouth alone is blocked, or both are blocked. In a study done by Gwaltney et al., it was found that during 18 different normal sneezing bouts, the mean intranasal pressure was 0.613 ± 0.507 kPa, but there was a huge increase

Table 2. Summary of Demographical Data for Sneeze Injuries.

	Gender	
	Male	Female
N ^a	38	9
Mean age (range) ^b	36 (15–72)	52 (18–84)
Comorbid risk factor	21	3
Site of injury		
Intrathoracic		
Laryngeal/pharyngeal	9	2
Orbital/ocular	7	0
Intracranial/neurologic	11	2
Otologic	6	3
Other	1	1

^aGender not reported for 5 cases.
^bAge not reported for 2 cases.

in transient intranasal pressure that can be disseminated to other areas causing injury when suppressed.⁵⁴ Sneezing with a closed mouth resulted in nasal pressures of 17.4 ± 4.9 kPa.⁵⁴ In another study done by Rahiminejad et al., computed tomography scans were used to simulate airway pressure and volume flow. They found that sneezing with the mouth closed results in a nasal pressure that is more than 6 times greater than a normal sneeze, reaching up to 21.8 kPa.² These large jumps in pressure make suppressing a sneeze potentially dangerous.

Prevention of sneeze injury can only be extrapolated from the case reports and airway data. Holding in a sneeze should be avoided to prevent massive Valsalva pressures. Reduction of sneezing is also desired for chronic inflammatory diseases; but in a healthy state,

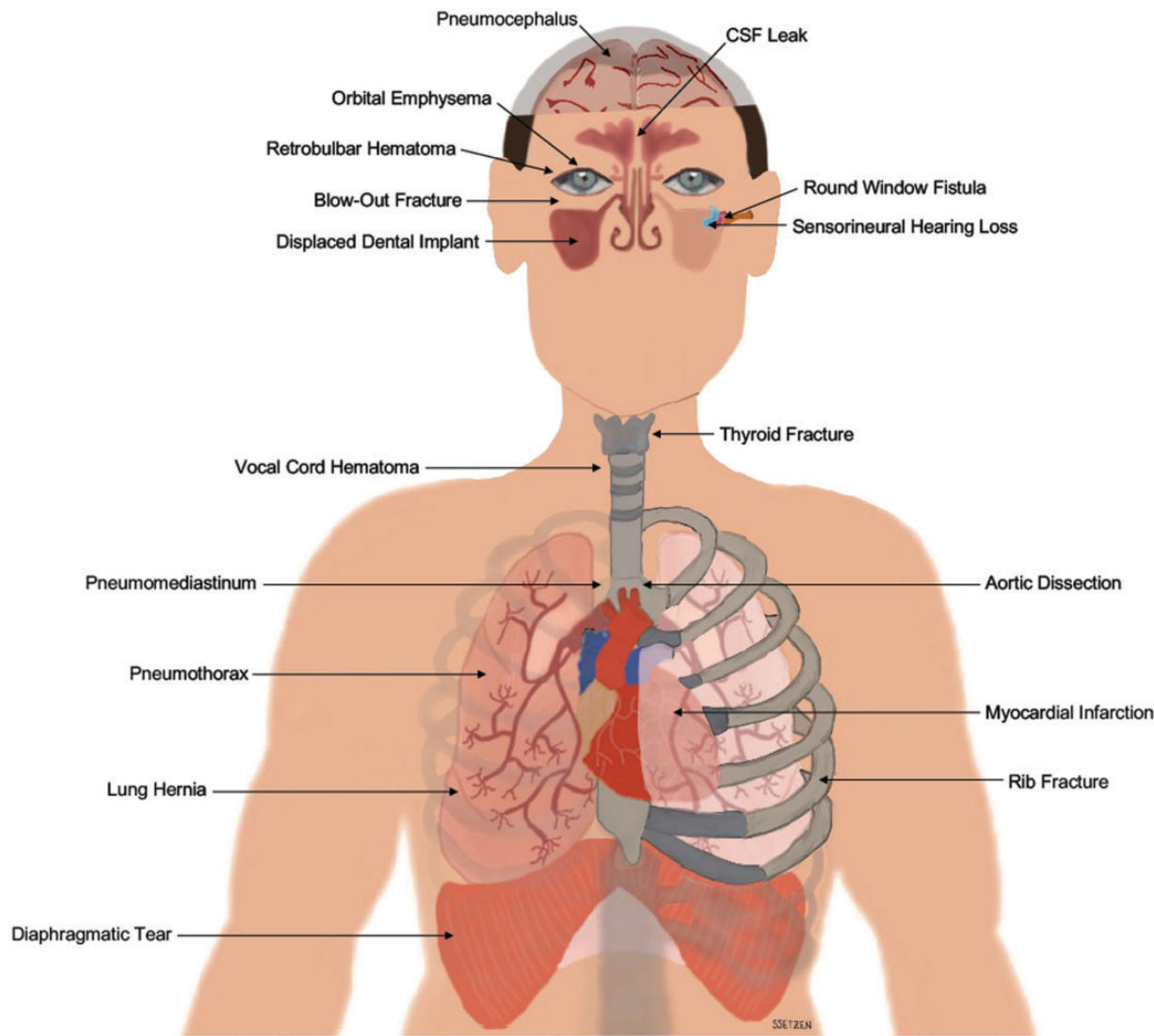


Figure 1. Anatomical regions of sneeze-related injuries were reported.

sneezing is an important defense mechanism to clear the airway.

Conclusion

A variety of injuries can occur during a sneeze, especially when a closed-airway sneeze is attempted. Men are thought to be more at risk due to the increased lung volumes and pressures. The high Valsalva pressure generated during a closed sneeze can be transmitted to the upper airway, lower airway, cranial vault, orbit, ear, and vascular system. Risk factors for sneeze injury were present in only 30% of cases, highlighting the rare but potential risk to all people who sneeze. When triggered, sneezing should be allowed to proceed without closed-airway intervention to prevent associated injuries.

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Michael Platt is a consultant for GI Reviewers, Inc, which does not have any relationship to this report.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

References

- Baraniuk JN, Kim D. Nasonasal reflexes, the nasal cycle, and sneeze. *Curr Allergy Asthma Rep*. 2007;7(2):105–111.
- Rahiminejad M, Haghighi A, Dastan A, Abouali O, Farid M, Ahmadi G. Computer simulations of pressure and velocity fields in a human upper airway during sneezing. *Comput Biol Med*. 2016;71:115–127.
- Ababneh OH. Orbital, subconjunctival, and subcutaneous emphysema after an orbital floor fracture. *Clin Ophthalmol*. 2013;7:1077–1079.
- Andreoli CM, Leff GB, Rizzo JF. Sneeze-induced visual and ocular motor dysfunction. *Am J Ophthalmol*. 2002;133(5):725–727.
- Roselle HA, Herman M. A hearty sneeze. *Lancet (London, England)*. 2010;376(9755):1872.
- Sen D, Chaturvedi PK. Orbital emphysema after sneezing: a case report. *Med J Armed Forces India*. 2011;67(3):282–284.
- Yilmaz F, Özlem M, Aslan Ö, Yel C. Orbital emphysema and orbital floor fracture following a severe and prolonged sneezing attack. *Hong Kong J Emerg Med*. 2015;22(4):256–258.
- Akyol PY, Ünlüer EE, Oyar O, Bilgin S. An unexpected complication of sneezing: blow-out orbital fracture. *J Emerg Trauma Shock*. 2015;8(3):172–173.
- Birkent H, Durmaz A, Hidir Y, Erdem U, Tosun F. Sneezing-related orbital emphysema and pneumocephalus treated with transnasal endoscopic surgery. *J Otolaryngol Head Neck Surg*. 2008;37(6):E167–E169.
- Chiu W-C, Huang T-Y, Ku W-C, Lih M, Wang W. Spontaneous orbital subcutaneous emphysema after sneezing. *Am J Emerg Med*. 2008;26(3):381.e1–381.e2.
- Deveer M, Cullu N, Beydilli H, Sozen H, Yeniceri O, Parlak S. Spontaneous retrobulbar haematoma. *Case Rep Radiol*. 2015;2015:796834.
- Gauguet J-M, Lindquist PA, Shaffer K. Orbital emphysema following ocular trauma and sneezing. *Radiol Case Reports*. 2008;3(1):124.
- Khader QA, Abdul-Baqi KJ. Orbital emphysema after a protracted episode of sneezing in a patient with no history of trauma or sinus surgery. *Ear Nose Throat J*. 2010;89(11):E12–E13.
- Koçak N, Öztürk T, Zengin MO, Kaynak S, Men S. Unilateral orbital emphysema after sneezing. *Ann Ophthalmol (Skokie)*. 2009;41(3–4):195–198.
- Reeves DL, Lucarelli MJ, Rose JG. Severe subcutaneous emphysema following orbital blowout fracture. *Ophthalm Plast Reconstr Surg*. 2005;21(6):465–467.
- Bhardwaj H, Bhardwaj B, Youness HA. A painful sneeze: spontaneous thoracic lung herniation induced by vigorous sneeze. *J Bronchology Interv Pulmonol*. 2014;21(1):61–64.
- Bourne CL. The perils of sneezing: bilateral spontaneous pneumothorax. *J Emerg Trauma Shock*. 2013;6(2):138–139.
- Tewfik MA, Al-Qahtani K, Payne RJ, Frenkiel S. Pneumomediastinum and cervicofacial emphysema following a nasally obstructed sneeze. *J Otolaryngol*. 2006;35(5):355–357.
- Turner M, Benton PJ. Three cases of pneumomediastinum—after labour, sneezing and compressed-air diving. *J R Soc Med*. 1998;91(5):268–269.
- Souza R, Figueiredo C, Rocha AJ. Pneumomediastinum after sneezing. *Thorax*. 2009;64(12):1104.
- Brock MV, Heitmiller RF. Spontaneous anterior thoracic lung hernias. *J Thorac Cardiovasc Surg*. 2000;119(5):1046–1047.
- Dechambre S, d'Odémont JP, Cornelis JP, Fastrez J. Spontaneous pneumomediastinum after sneezing. *Ann Thorac Surg*. 1995;60(5):1457.
- García-Tirado J, Landa-Oviedo HS, Suazo-Guevara I. Spontaneous bilateral chylothorax caused by a sneeze: an unusual entity with good prognosis. *Arch Bronconeumol (English Ed)*. 2017;53(1):32–33.
- Jüch M, Wertzel H, Riemann T, Ludwig K, Achenbach H. Rippenfraktur, Zwerchfellruptur und Thoraxwandhernie nach starkem Niesen. *Zentralblatt für Chir – Zeitschrift für Allg Visz Thorax- und Gefäßchirurgie*. 2014;140(3):337–338.
- Karangizi AHK, Renaud SJ, Rao JN, Chetty G. Diaphragmatic and intercostal muscle tear after an episode of violent sneezing: spontaneous diaphragmatic injury. *Ann Thorac Surg*. 2013;96(1):301–302.
- Law ST, Wong KCK, Tse CF. Cervical subcutaneous emphysema and pneumomediastinum after sneezing. *Hong Kong Med J = Xianggang yi xue za zhi*. 2013;19(2):188.e3–188.e4.
- Macdonald RG, Kelly J. Cervico-mediastinal haematoma following sneezing. *Anaesthesia*. 1975;30(1):50–53.
- Mitsakos AT, Finnesgard EJ, Pandian TK, Zeb MH, Farley DR, van Heerden JA. This diagnosis is nothing to sneeze at! *Surgery*. 2016;160(2):523–524.

29. Álvarez M, Montojo T, de la Casa B, Vela L, Pareja JA. Unilateral nasal pain with migraine features. *Cephalalgia*. 2013;33(12):1055–1058.
30. Fonseca AC, Ferreira JJ, Albuquerque L, Ferro JM. Sneeze as a precipitating factor of cerebral venous thrombosis. *Eur J Neurol*. 2007;14(10):e7–e8.
31. Gutowski NJ, Murphy RP, Beale DJ. Unilateral upper cervical posterior spinal artery syndrome following sneezing. *J Neurol Neurosurg Psychiatry*. 1992;55(9):841–843.
32. Harrison MJ. Transient ischaemic attacks related to carotid stenosis precipitated by straining, bending, and sneezing. *Postgrad Med J*. 1999;75(881):145–146.
33. Rottger C, Trittmacher S, Gerriets T, Kaps M, Stolz E. Sinus thrombosis after a jump from a small rock and a sneezing attack: minor endothelial trauma as a precipitating factor for cerebral venous thrombosis? *Headache J Head Face Pain*. 2004;44(8):812–815.
34. Štětkařová I, Jelínková L, Janík V, Peisker T. Spontaneous spinal epidural hematoma after abrupt sneezing with prompt recovery of severe paraparesis. *Am J Emerg Med*. 2014;32(12):1555.e3–1555.e5.
35. Stokes V, Küker W, Schulz UG. Gesundheit! Sneezing, paraesthesiae and ataxia in a 35-year-old man. *Pract Neurol*. 2011;11(6):362–365.
36. van Oosterhout WPJ, Haan J. Migraine after sneezing: pathophysiological considerations, focused on the difference with coughing. *Headache J Head Face Pain*. 2013;53(7):1147–1151.
37. Wu Y-H, Yeh I-J, Liu K-T. Spontaneous pneumocephalus and subdural hemorrhage after sneezing. *Am J Emerg Med*. 2018;36(10):1928.e1–1928.e3.
38. Yun-xu Z, Long-xi L, Xiao-zhong Q. A case report of diffuse pneumocephalus induced by sneezing after brain trauma. *Chinese J Traumatol*. 2013;16(4):249–250.
39. Faden DL, Elackattu A, Platt M. The “Closed-Airway Sneeze.” *Otolaryngol Neck Surg*. 2011;145(3):515–516.
40. Forner D, Phillips T, Brown T. Laryngeal injury and subcutaneous emphysema caused by an episode of sneezing: a rare case treated with observation alone. *J Laryngol Voice*. 2016;6(1):21.
41. Genovesi MG, Simmons DH. Airway obstruction due to spontaneous retropharyngeal hemorrhage. *Chest*. 1975;68(6):840–842.
42. Morvan J-B, Veyrières J-B, Mimouni O, Maugey N, Cathelinaud O, Verdalle P. Perforation of the piriform sinus after sneezing with cervical subcutaneous emphysema and pneumomediastinum. *Eur Ann Otorhinolaryngol Head Neck Dis*. 2011;128(3):147–149.
43. Quinlan PT. Fracture of thyroid cartilage during a sneezing attack. *Br Med J*. 1950;1(4661):1052.
44. Reuther MS, Weissbrod PA. Voice change, odynophagia, and neck pain following a sneeze. *JAMA Otolaryngol Neck Surg*. 2017;143(1):89.
45. Santamaría A, Alarcón R, Sepúlveda I, Fredes F. Nontraumatic laryngeal fractures: report of two cases and review of the literature. *Case Rep Otolaryngol*. 2017;2017:2153521.
46. Comacchio F, Mion M. Sneezing and perilymphatic fistula of the round window: case report and systematic review of the literature. *J Int Adv Otol*. 2018;14(1):106–111.
47. Garry D, Forrest-Hay A. A headache not to be sneezed at. *Emerg Med J*. 2009;26(5):384–385.
48. Whitehead E. Sudden sensorineural hearing loss with fracture of the stapes footplate following sneezing and parturition. *Clin Otolaryngol Allied Sci*. 1999;24(5):462–464.
49. Baydin A, Nural MS, Güven H, Deniz T, Bildik F, Karaduman A. Acute aortic dissection provoked by sneeze: a case report. *Emerg Med J*. 2005;22(10):756–757.
50. Hirsch S, Coelho D, Schuman T. Subcutaneous emphysema after vigorous sneezing in the setting of acute frontal sinusitis. *Am J Otolaryngol*. 2017;38(2):244–247.
51. Procacci P, De Santis D, Bertossi D, et al. Extraordinary sneeze: spontaneous transmaxillary-transnasal discharge of a migrated dental implant. *World J Clin Cases*. 2016;4(8):229–232.
52. Therrien ML, Moreno B, Korr KS, Heller GV. Acute myocardial infarction associated with prolonged sneezing. *Am J Cardiol*. 1987;59(4):364–365.
53. Upadhyaya SGN, Large A. A sneeze: an unusual trigger for aortic dissection. *BMJ Case Rep*. 2013;2013: bcr2013200619.
54. Gwaltney JM, Hendley JO, Phillips CD, Bass CR, Mygind N, Winther B. Nose blowing propels nasal fluid into the paranasal sinuses. *Clin Infect Dis*. 2000;30(2):387–391.
55. Bellemare F, Jeanneret A, Couture J. Sex differences in thoracic dimensions and configuration. *Am J Respir Crit Care Med*. 2003;168(3):305–312.