

Supplemental Table 1. Appraisal of study quality and bias using modified Newcastle-Ottawa scale

Study	modified NOS 1	modified NOS 2	modified NOS 3	modified NOS 4	modified NOS 5	Risk of bias
Adolph 1994	1	2	1	2	2	Moderate
Ansa 2006	1	2	2	2	1	Moderate
Bachmann 1987	1	2	1	2	2	Moderate
Bhattacharya 2016	1	2	2	2	2	Low
Cascade 1993	1	2	2	2	2	Low
Choi 2015	1	2	2	2	2	Low
Choi 2016	1	2	2	2	2	Low
Chuang 2007	1	2	2	2	1	Moderate
Dash 1983	1	2	1	2	1	Moderate
Dedio 1989	1	2	1	2	1	Moderate
DeSio 1993	1	2	2	2	2	Low
Dicpinigaitis 1995	1	2	2	2	2	Low
Dieu 2003	1	2	2	2	1	Moderate
Dolinski 2000	1	2	2	2	2	Low
Frank 1986	1	2	2	1	1	Moderate
Furuhashi-Yonaha 2000	1	2	2	2	2	Low
Gabbott 1997	1	2	1	2	1	Moderate
Goldenberg 1997	2	2	2	2	1	Low
Goli 2003	1	2	2	1	1	Moderate
Gupta 2001	1	2	2	2	2	Low
Guru 2018	1	2	2	2	2	Low
Hendler 1993	1	2	2	2	2	Low
Hochberg 2014	1	2	2	2	2	Low
Hong 2014	1	2	2	2	2	Low
Hsu 1985	1	2	2	2	2	Low
Hussain 2008	1	2	2	2	1	Moderate
Ikeda 2006	1	2	2	2	1	Moderate
Ingrams 1997	1	2	1	2	2	Moderate
Jain 1997	2	2	1	2	1	Moderate
Jenkins 1984	1	2	1	1	2	Moderate
Kadota 1998	2	2	2	2	1	Low
Kallet 1998	1	2	1	2	1	Moderate
Kaya 1998	1	2	2	2	1	Moderate
Kim 2012	1	2	2	2	2	Low
Kioi 1998	1	2	1	2	1	Moderate
Lathan 1999	1	2	1	2	2	Moderate

Lim 2000	1	2	1	2	1	Moderate
Lloyd 2003	1	2	1	2	1	Moderate
Lorch 1986	1	2	2	2	2	Low
Mamiya 2009	1	2	2	2	1	Moderate
Marino 2009	1	2	2	2	1	Moderate
Maroof 1994	1	2	1	2	1	Moderate
McConkey 2000	2	2	2	2	1	Low
McShane 1997	1	2	2	2	1	Moderate
Mehta 2006	2	2	1	1	1	Moderate
Melnick 1984	1	2	1	1	1	High
Miro 1989	1	2	2	2	2	Low
Mussi 2008	1	2	1	2	1	Moderate
Olsen 1990	1	2	2	2	1	Moderate
Oswalt 1977	1	2	1	2	1	Moderate
Price 1987	1	2	1	2	2	Moderate
Randour 1986	1	2	2	2	1	Moderate
Rivera 1979	1	2	2	2	2	Low
Roopa 2012	1	2	2	2	1	Moderate
Scarborough 1997	1	2	2	2	2	Low
Sharma and Jain 2007	1	2	2	2	2	Low
Sharma 2002	1	2	1	2	2	Moderate
Sharma 2008	1	2	1	2	1	Moderate
Sharma et al. 2007	1	2	1	2	2	Moderate
Siddiqi 2006	1	2	2	2	2	Low
Siddique 2009	1	2	2	2	2	Low
Singh 2014	1	2	2	2	2	Low
Soldano 1993	1	2	1	2	2	Moderate
Tami 1986	1	2	2	1	1	Moderate
Wadhwa 2010	1	2	2	1	1	Moderate
Waheed 2011	1	2	2	2	1	Moderate
Westreich 2006	1	2	2	2	2	Low
Wilson 1995	1	2	2	2	2	Low
Wu 2015	1	2	2	2	2	Low

Modified Newcastle-Ottawa Scale questions: 1. Did the patient(s) represent the entire case(s) of the medical center? 2. Was the diagnosis correctly made? 3. Were other differential diagnoses ruled out? 4. Was the outcome correctly ascertained? 5. Is the case(s) described with sufficient details to allow other investigators to replicate the research or to allow practitioners make inferences related to their own practice? Each category was rated either “1” denoting no, or “2” denoting yes. The total score was then tabulated. The study was considered a high risk of bias if the total score added was 5 to 6, moderate risk of bias for 7 to 8, and low risk of bias for 9 to 10.

Supplemental Table 2. List of included studies and pertinent findings

Study	Age	Sex	Comorbidities	Type of anesthesia	Surgery	Event leading to NPPE	Outcome	Recovery time	Length of hospital stay
Adolph 1994	43	M	obese	local anesthesia	tracheostomy	relief of airway obstruction from epiglottitis by tracheostomy	death	N/A	17 days
Ansa 2006	47	M	none	general, endotracheal intubation	septoplasty	unclear	full recovery	NR	1 day
Bachmann 1987	67	M	DVT, hyperuricemia	local anesthesia	cricothyroidotomy	relief of obstruction from cervical hematoma by tracheostomy	full recovery	30 hours	14 days
Bhattacharya 2016	25	M	none	general, endotracheal intubation	repair of zygomatic and maxillary fractures	biting on endotracheal tube	full recovery	17 hours	4 days
Cascade 1993	19	M	none	general, endotracheal intubation	mandibular osteotomy	UAO event post extubation	full recovery	21 hours	NR
	25	M	none	general, endotracheal intubation	rhinoplasty	laryngospasm	full recovery	NR	NR
Choi 2015	66	F	hypertension, type 2 diabetes	general, endotracheal intubation	reduction orbital wall and nasal bone fracture	laryngospasm	full recovery	36 hours	7 days
Choi 2016	32	M	none	none	cricothyroidotomy	relief of airway obstruction from supraglottitis by cricothyroidotomy	hypoxic brain damage	24 hours	NR
Chuang 2007	49	F	Grave's disease post thyroidectomy with BL vocal cord paresis	local anesthesia	tracheostomy	relief of airway obstruction by tracheostomy	full recovery	48 hours	NR
	20	M	none	general, endotracheal intubation	adenoidectomy, myringotomy tubes	UAO event post extubation	full recovery	72 hours	NR
	21	F	none	general, endotracheal intubation	microlaryngeal surgery	laryngospasm	full recovery	48 hours	NR
Dash 1983	30	M	none	none	neck exploration for tracheal tear and dislodged tracheostomy tube	removing dislodged tracheostomy and replacement with endotracheal tube	full recovery	6 hours	17 days
Dedio 1989	19	M	none	general, endotracheal intubation	tonsillectomy	relief of airway obstruction by tonsillectomy	full recovery	NR	2 days
DeSio 1993	59	F	metastatic breast cancer	none	tracheostomy, bronchoscopy	relief of airway obstruction by removal of foreign body	cardiac arrest, death	N/A	NR
Dicpinigaitis 1995	29	M	OSA	general, endotracheal intubation	septoplasty, ethmoidectomy	biting on endotracheal tube	full recovery	24 hours	2 days
Dieu 2003	36	M	none	general, endotracheal intubation	rhinoplasty	unclear	full recovery	NR	5 days
Dolinski 2000	33	F	none	general, endotracheal intubation	septoplasty	laryngospasm	full recovery	NR	14 days

Frank 1986	38	F	none	general, endotracheal intubation	esophageal dilation	UAO event post extubation	full recovery	24 hours	NR
Furuhashi-Yonaha 2000	27	M	none	general, endotracheal intubation	tonsillectomy	UAO event post extubation while sleeping	full recovery	24 hours	NR
Gabbott 1997	21	M	none	general, nasotracheal	reduction mandible fracture	laryngospasm	full recovery	24 hours	few days
Goldenberg 1997	23	F	obesity, OSA	general, endotracheal intubation	tonsillectomy	laryngospasm	full recovery	18 hours	2 days
Goli 2003	31	M	none	general, endotracheal intubation	septoplasty	laryngospasm	full recovery	36 hours	NR
Gupta 2001	70	F	tracheal stenosis with stent	general, endotracheal intubation	bronchoscopy, cryotherapy of suprastomal granulation	relief of tracheal obstruction by removal flaps of tissue within trachea	cardiac arrest, death	N/A	NR
Guru 2018	64	M	liver cirrhosis from hepatitis c, hepatocellular carcinoma, peripheral neuropathy	general, endotracheal intubation	excision vocal cord papilloma	unclear	full recovery	12 hours	NR
Hendler 1993	32	F	none	general, endotracheal intubation	arthroscopy and debridement of right TMJ	UAO event post extubation from soft palate edema	full recovery	24 hours	2 days
Hochberg 2014	31	M	none	none	cricothyroidotomy	relief of airway obstruction from epiglottitis by cricothyroidotomy	full recovery	several hours	NR
Hong 2014	26	M	none	general, nasotracheal intubation	Lefort 1 repair and sagittal split osteotomy	UAO event post extubation	full recovery	12 hours	5 days
Hsu 1985	26	F	none	general, endotracheal intubation	subtotal thyroidectomy	laryngospasm	full recovery	24 hours	NR
	48	M	leukemia	general, endotracheal intubation	microlaryngeal surgery	UAO event post extubation	septic shock, death	24 hours	NR
Hussain 2008	30	M	none	general, endotracheal intubation	septoplasty	laryngospasm	full recovery	4 hours	NR
Ikeda 2006	50	M	mediastinal goiter, tracheal compression	general, endotracheal intubation	substernal thyroidectomy	relief of obstruction by removal of large thyroid goiter	full recovery	NR	NR
Ingrams 1997	44	M	none	general, endotracheal intubation	posterior nasal packing for epistaxis	laryngospasm	full recovery	12 hours	5 days
Jain 1997	18	M	none	general, endotracheal intubation	septoplasty	relief of airway obstruction from blood clot removed	full recovery	24 hours	5 days
Jenkins 1984	60	F	pharyngeal cancer s/p pharyngectomy and radiation	general, endotracheal intubation	direct laryngoscopy, vocal cord stripping	laryngospasm	full recovery	24 hours	NR
Kadota 1998	33	M	OSA	general, endotracheal intubation	tonsillectomy, pharyngoplasty	laryngospasm	full recovery	24 hours	10 days
Kallet 1988	24	M	none	general, endotracheal intubation	removal aspirated foreign body	relief of airway obstruction by foreign body by intubation	full recovery	12 hours	NR
	25	M	none	general, endotracheal intubation	repair orbital floor and zygomatic arch	biting on endotracheal tube	full recovery	17 hours	4 days

Kaya 1998	37	M	none	general, endotracheal intubation	septoplasty	NR	NSTEMI	NR	4 days
Kim 2012	65	F	hypertension, papillary thyroid carcinoma, minor depression, cerebral infarction	general, endotracheal intubation	total thyroidectomy	UAO event post extubation	full recovery	6 days	NR
Kioi 1998	84	F	oral cancer	general, endotracheal intubation	tumor resection and partial mandibulectomy	UAO by tongue edema post extubation	full recovery	12 hours	NR
	23	M	none	general, endotracheal intubation	tracheotomy, open reduction of fixation of maxillofacial fracture	relief of airway obstruction from tracheostomy misplacement by intubation	full recovery	8 hours	NR
Lathan 1999	66	M	none	general, endotracheal intubation	exploratory tympanotomy	laryngospasm	full recovery	24 hours	NR
Lim 2000	23	M	none	general, endotracheal intubation	extraction wisdom tooth	UAO event post extubation	full recovery	24 hours	2 days
Lloyd 2003	22	M	none	general, endotracheal intubation	reduction fractured mandible	laryngospasm	full recovery	14 days	24 days
Lorch 1986	48	M	hypertension, obesity	general, endotracheal intubation	triple endoscopy	UAO event post extubation	full recovery	6 hours	NR
Mamiya 2009	27	M	depression	general, nasotracheal	extraction of molars, plate removal from prior jaw surgery	UAO event post extubation	full recovery	24 hours	10 days
Marino 2009	22	F	obesity	general, endotracheal intubation	septoplasty, turbinate reduction	UAO event post extubation	full recovery	96 hours	7 days
Maroof 1994	33	M	none	general, endotracheal intubation	repair oronasal fistula via Caldwell Luc approach	obstruction of larynx with nasal Foley catheter packing	full recovery	16 hours	5 days
McConkey 2000	21	M	esophageal reflux	general, endotracheal intubation	excision suspected melanoma from ear	laryngospasm	full recovery	24 hours	NR
McShane 1997	55	M	overweight	general, endotracheal intubation	rhytidoplasty	laryngospasm	hypoxic brain injury	NR	NR
Mehta 2006	18	F	ASA1/2	general, endotracheal intubation	adenotonsillectomy	laryngospasm	full recovery	24 hours	3 days
	24	M	ASA1/2	general, endotracheal intubation	tonsillectomy	laryngospasm	full recovery	24 hours	2 days
	25	M	ASA1/2	general, endotracheal intubation	rhinoplasty	laryngospasm	full recovery	24 hours	1 day
	31	F	ASA1/2	general, endotracheal intubation	ESS/turbinectomy	laryngospasm	full recovery	24 hours	1 day
	35	M	none	general, endotracheal intubation	septoplasty, ESS	laryngospasm	full recovery	24 hours	2 days
	39	M	none	general, endotracheal intubation	ESS	laryngospasm	full recovery	24 hours	1 day
	40	M	ASA1/2	general, endotracheal intubation	nasopharyngeal biopsy, myringotomy tube	laryngospasm	full recovery	24 hours	1 day

	42	F	ASA1/2	general, endotracheal intubation	hemithyroidectomy	laryngospasm	full recovery	24 hours	2 days
	48	F	ASA1/2	general, endotracheal intubation	septoplasty	laryngospasm	full recovery	24 hours	1 day
Melnick 1984	48	M	hypertension	general, endotracheal intubation	bronchoscopy, laryngoscopy	laryngospasm	full recovery	24 hours	NR
	21	M	none	general, endotracheal intubation	septorhinoplasty	laryngospasm	full recovery	3 hours	NR
Miro 1989	71	F	lung cancer	general, endotracheal intubation	bronchoscopy, laser excision lower tracheal mass	relief of airway obstruction by removal tracheal lesion	full recovery	24 hours	2 days
Mussi 2008	25	M	tracheal stenosis	sedation	bronchoscopy	UAO after extubation from mediastinal abscess	full recovery	72 hours	17 days
Olsen 1990	50	F	none	general, endotracheal intubation	laryngoscopy, vocal cord biopsy	laryngospasm	full recovery	24 hours	NR
Oswalt 1977	62	M	COPD, laryngeal cancer	general, endotracheal intubation	tracheostomy	relief of airway obstruction by trach	full recovery	NR	14 days
Price 1987	27	F	mediastinal/cervical Hodgkin's lymphoma	general, endotracheal intubation	open neck biopsy	UAO event post extubation	full recovery	24 hours	3 days
Randour 1986	79	M	smoker, bronchial cancer	general, endotracheal intubation	vocal cord biopsy	UAO event while intubated	MI and TIA	48 hours	NR
Rivera 1979	40	M	none	local anesthesia	tracheostomy	relief airway obstruction from acute epiglottitis by tracheostomy	full recovery	72 hours	9 days
Roopa 2012	29	M	none	general, endotracheal intubation	left mastoidectomy	laryngospasm	full recovery	NR	NR
Scarborough 1997	40	F	none	general, endotracheal intubation	reduction mandible fracture	UAO event post extubation	full recovery	48 hours	4 days
	21	F	none	general, endotracheal intubation	TMJ arthroscopy	UAO event post extubation	full recovery	5 hours	1 day
	28	M	none	general, nasotracheal tube	palatal expansion, tooth extraction	laryngospasm	full recovery	24 hours	1 day
Sharma and Jain 2007	18	M	none	general, endotracheal intubation	septoplasty	UAO event post extubation	hypoxic brain injury	20 hours	NR
Sharma 2002	60	F	Grave's disease, thyroid goiter	general, endotracheal intubation	thyroidectomy	UAO event post extubation from VC paresis and tracheomalacia	full recovery	96 hours	NR
Sharma 2008	50	F	papillary thyroid carcinoma, MEN	general, endotracheal intubation	thyroidectomy, parathyroidectomy	UAO event post extubation from left VC paralysis	full recovery	48 hours	NR
Sharma et al. 2007	60	M	hypertension, type 2 diabetes	general, endotracheal intubation	thyroidectomy, central neck dissection	UAO event post extubation from BL VC paralysis	full recovery	NR	11 days
Siddiqi 2006	29	M	smoker	general, endotracheal intubation	septoplasty	UAO event post extubation	full recovery	24 hours	7 days
Siddique 2009	22	M	none	general, endotracheal intubation	bronchoscopy	removal obstructing packing from bronchus	full recovery	NR	NR

Singh 2014	26	M	none	general, endotracheal intubation	rhinoplasty	UAO event post extubation	full recovery	4 hours	NR
Soldano 1993	24	M	None	general, endotracheal intubation	submental neck mass excision, panendoscopy	laryngospasm	full recovery	7 hours	NR
Tami 1986	45	F	rheumatoid arthritis	general, endotracheal intubation	direct laryngoscopy	relief of airway obstruction from arytenoid edema by intubation	full recovery	24 hours	NR
	57	F	laryngeal cancer	general, endotracheal intubation	tracheostomy	relief of airway obstruction by tracheostomy	full recovery	48 hours	NR
Wadhwa 2010	18	F	none	general, endotracheal intubation	rhinoplasty	UAO event post extubation	full recovery	NR	5 days
Waheed 2011	28	M	none	general, endotracheal intubation	extraction of molars	UAO event post extubation	full recovery	12 hours	1 day
Westreich 2006	28	M	none	general, endotracheal intubation	septorhinoplasty	UAO event post extubation	full recovery	12 hours	2 days
Wilson 1995	22	F	none	general, nasotracheal	extraction of molars	laryngospasm	full recovery	24 hours	NR
Wu 2015	18	F	relapsing polychondritis	none	tracheostomy	relief of airway obstruction by tracheostomy	full recovery	48 hours	NR

ASA = American Society of Anesthesiologists, BL = bilateral, COPD = chronic obstructive pulmonary disease, DVT = deep vein thrombosis, ESS = endoscopic sinus surgery, N/A = not applicable, NR = not recorded, TMJ = temporomandibular joint, MEN = multiple endocrine neoplasia, OSA = obstructive sleep apnea, UAO = upper airway obstruction, VC = vocal cord