INTUBATION GRANULOMA

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INTUBATION GRANULOMA is a rare complication of endotracheal anæsthesia. It is a condition, however, which is becoming more frequent, due to the increasing role of intubation in modern surgery. An understanding of the pathogenesis of intubation granuloma is of value not only in the prophylaxis but also in the treatment of this disease.

It is our object here to review the relevant literature, present some further cases and finally to discuss the significance of this subject. This paper forms part of a study of "Benign Laryngeal Tumours" based on an analysis of material at the Royal National Throat, Nose and Ear Hospital in London.

Review of Literature

A comprehensive review of the literature to date is presented in tabular form (Table I).

Incidence

There is no doubt that this condition is far more common than the 55 published cases here would suggest. P. J. Flagg in 1951 published the results of a questionnaire on endotracheal anæsthesia sent to a selected group of American surgeons. In the data of 34 surgeons replying, a total of 101 cases of intubation granuloma were incidentally mentioned.

Age and Sex

All recorded cases have been in adults and are four times commoner in females. This sex difference may merely be due to the smaller size of the female larynx. The apparent immunity of children is possibly only an expression of the rarity of intubation in this age group.

Site

Intubation granulomata are invariably found on the vocal processes of the arytenoids. Approximately half the cases reviewed here were bilateral.

Aetiology

Various theories have been postulated in an attempt to explain their cause and site but it is evident from an analysis of the literature that no single factor can be exclusively incriminated.

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TABLE I.

REVIEW OF LITERATURE.

Author	No. cases	Age	Sex	Pre-op. laryngoscopy	Nature of surgery	Relaxants	Duration Anæsthesia	Intubation		Difficulty	Latent period	Signs	Recurrence
								Tube	Route				
Clausen, R. 1932	1	Young	F.	—	Dental extraction	—	N.S.*	Soft Rubber	Nasal Direct Vision	+	150 d.	Unilateral (R)	—
Gould, R. B. 1935	1	—	F.	—	Hysterectomy	—	195 mins.	Magill 4	Nasal Blind	—	Immediate	Unilateral (L)	—
Cohen, M. 1938	1	49	F.	—	Cholecystectomy	—	50 mins.	Medium Magill	Nasal Blind	+	60 d.	Unilateral (R)	—
Smiley, W. A. 1940	1	—	—	—	Repair Common bile duct	—	90 mins.	Soft Rubber	Oral Direct Vision	N.S.	10 d.	Unilateral Pedunculated	—
Farrior, J. B. 1942	1	60	F.	—	Ethmoidectomy	—	205 mins.	Cuffed	Oral Direct Vision	N.S.	13 d.	Unilateral (R)	—
Kearney, H. 1946	1	49	F.	—	Removal Alveolar cyst	—	80 mins.	Magill	Nasal Direct Vision	+	34 d.	Bilateral	—
Robin, I. G. 1946	1	50	F.	—	2 Gynæcological operations	—	N.S.	N.S.	N.S.	N.S.	Immediate	Bilateral	—
Barton, L. 1947	2	40	F.	—	Thyroidectomy	—	—	N.S.	Direct Vision	N.S.	70 d.	Unilateral (R) Pedunculated	—
		54	M.	—	Removal Craniopharyngioma	—	300 mins.	N.S.	Direct Vision	N.S.	60 d.	Unilateral (R) Pedunculated	—
McLaurin, J. 1947	1	25	F.	—	Tonsillectomy	—	40 mins.	Magill 35	Oral Direct Vision	—	17 d.	Bilateral R. Pedunculated L. Sessile	—
Tuft, H. S. Ratner, S. H. 1947	1	49	F.	Laryngitis	Gastrectomy	—	220 mins.	Magill	N.S.	N.S.	28 d.	Bilateral Pedunculated	—
Finer, G. H. 1948	1	54	F.	—	Laminectomy	—	220 mins.	French 35	Oral Direct Vision	—	Immediate	Unilateral (R)	N.S.
Hill, F. T. 1948	1	40	M.	—	Two-stage Sympathectomy	—	300 mins. 240 mins.	Magill 32	Oral Direct Vision	N.S.	150 d.	Bilateral L. Pedunculated R. Sessile	(R)
El Mofti, A. 1949	2	23	F.	—	Tonsillectomy	—	N.S.	Magill	Nasal Blind	+	60 d.	Unilateral (L) Pedunculated	—
		54	M.	—	Mastoidectomy	—	N.S.	Large Head Tube	Nasal Blind	+	120 d.	Unilateral (L) Pedunculated	—

Author	No. cases	Age	Sex	Pre-op. laryngoscopy	Nature of surgery	Relaxants	Duration Anæsthesia	Intubation		Difficulty	Latent period	Signs	Recurrence
								Tube	Route				
Wattles, M. 1949	1	32	F.	-	Thyroidectomy	-	100 mins.	Magill 35	Direct Vision	-	14 d.	Bilateral and Pedunculated	-
New, G. B., and Devine, K. D. 1949	9	N.S.	F.(6) M.(3)				N.S.		N.S.	N.S.	N.S.	Unilateral (2) Bilateral (7)	+ in 5 cases
Ezz El Din El-Samna 1950	2	49	M.		Prolapsed disc		N.S.	N.S.	N.S.	-	56 d.	Bilateral Pedunculated(L.)	-
		40	F.		Tonsillectomy		N.S.	N.S.	N.S.	N.S.	60 d.	Unilateral (R)	-
Macneil, F. A. 1951	1	37	F.		-		90 mins.	N.S.	N.S.	N.S.	Immediate	Unilateral (R) Pedunculated	-
Baron, S. H., and Kohlmoos, H. W. 1951	7	42	F.		Exploration Common duct		165 mins.	N.S.	N.S.	N.S.	21 d.	Bilateral Pedunculated	+ (R)
		Adult	F.		Laminectomy		195 mins.	N.S.	N.S.	N.S.	4 d.	Unilateral (L) Pedunculated	-
		48	F.		Reduction-fracture		N.S.	N.S.	N.S.	N.S.	14 d.	Bilateral	-
		44	F.		Gastrectomy		210 mins.	N.S.	N.S.	N.S.	Immediate	Unilateral (R)	-
		48	F.		Gastrectomy		N.S.	N.S.	N.S.	N.S.	120 d.	Bilateral	-
		30	M.		Laminectomy		N.S.	N.S.	N.S.	N.S.	Immediate	Bilateral	-
		Adult	M.		Thyroidectomy	—	N.S.	N.S.	N.S.	N.S.	120 d.	Unilateral (L) Pedunculated	-
Wright, W. K. 1951	1	59	F.		Gastrectomy	-	240 mins.	Latex 32	Direct Vision	-	42 d.	Bilateral Pedunculated	-
Peimer, R., and Feuerstein, S. 1951	4	35	F.		Thyroidectomy	-	170 mins.	Magill	Nasal Direct Vision	N.S.	63 d.	Unilateral (L) Pedunculated	-
		57	F.		Colectomy	-	300 mins.	N.S.	N.S.	-	210 d.	Unilateral (L) Pedunculated	+ (L)
		70	M.		Colectomy	-	150 mins.	N.S.	Blind	-	60 d.	Bilateral Pedunculated	-
		39	F.	-	Mastectomy	—	120 mins.	N.S.	N.S.	N.S.	28 d.	Unilateral (R)	-
Brown, L. A. 1952	1	29	F.	-	Lacerations	—	90 mins.	Magill 6	Nasal Blind	—	42 d.	Bilateral Pedunculated	-

*N.S.—Not stated.

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TABLE I.—*cont.*

Author	No. cases	Age	Sex	Pre-op. laryngoscopy	Nature of surgery	Relaxants	Duration Anæsthesia	Intubation		Difficulty	Latent period	Signs	Recurrence
								Tube	Route				
Leiberman, G. 1952	1	47	F.	+	Hysterectomy	—	180 mins.	Magill 32	Nasal Blind	+	5 d.	Bilateral	—
Heller, M. F. 1953	1	29	F.	—	Thyroglossal cyst	—	N.S.	N.S.	N.S.	N.S.	35 d.	Bilateral	—
Kamsler, P. M. 1953	1	33	F.	—	Valviotomy	—	180 mins.	Magill 32	Oral Direct Vision	—	Immediate	Unilateral (R) Pedunculated	—
Joannovich, D. 1953	1	21	F.	—	Spinal fusion	+	21 mins.	Magill 34	Direct Vision	—	2 d.	Bilateral (L) Pedunculated	—
Matzker, J. 1953	2	51	F.	+	Appendicectomy	—	40 mins.	Round tube 9 mm. dia.	Direct Vision	—	14 d.	Bilateral	—
		30	F.	+	Cholecystectomy	—	85 mins.	Round tube 9 mm. dia.	Direct Vision	—	Immediate	Bilateral Pedunculated	—
Barton, R. T. 1953	4	38	M.	—	Spinal Fusion	—	N.S.	N.S.	N.S.	N.S.	Immediate	Unilateral (L) Pedunculated	—
		55	F.	—	Spinal Fusion	—	N.S.	N.S.	N.S.	N.S.	30 d.	Unilateral (R) Pedunculated	N.S.
		44	F.	—	Craniotomy	—	N.S.	N.S.	N.S.	N.S.	Immediate	Unilateral (R) Pedunculated	—
		88	F.	—	Thyroidectomy	—	N.S.	N.S.	N.S.	N.S.	N.S.	Unilateral (R)	N.S.
Feinmesser, M. *et al.* 1954	2	39	F.	—	Cæsarean Section	—	50 mins.	Magill 9	N.S.	—	90 d.	Unilateral (L) Pedunculated	—
		53	F.	—	Gastrectomy	+	120 mins.	Soft Rubber	N.S.	+	Immediate	Unilateral (R) Pedunculated	—
Melick, D. W., *et al.* 1954	1	28	F.	—	Lobectomy	+	260 mins.	N.S.	N.S.	—	Immediate	Bilateral Pedunculated	—

* N.S.—Not stated,

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TABLE II.

ANALYSIS OF CASES REPORTED BY THE AUTHORS.

Case	Age	Sex	Surgery	Duration	Relaxants	Intubation		Latent period	Symptoms	Signs	Treatment	Recurrence
						Tube	Route					
1	21	F.	Rhino-plasty	N.S.	—	Standard Magill	Orally Direct Vision	196 d.	Hoarseness	Unilateral (R) Sessile	Removal under G.A.	—
2	47	M.	Gastrectomy	N.S.	+	N.S.	N.S.	224 d.	Hoarseness	Unilateral (R) Pedunculated	Removal under L.A.	—
3	64	F.	Mastoidectomy	N.S.	+	Magill 10	Orally Direct Vision	28 d.	Hoarseness	Bilateral	Removal under G.A.	—
4	68	M.	Exploration and Biopsy post nasal space	N.S.	+	Magill 10	Orally Direct Vision	84 d.	Dysphonia "Sensation in throat"	Unilateral (R)	Removal under G.A.	—
5	62	M.	Tonsillectomy	30 mins.	N.S.	Standard Magill	Nasal	28 d.	Hoarseness	Unilateral (R) Sessile	Spontaneous disappearance during 2 weeks observation period	—
6	53	F.	Thyroidectomy	N.S.	+	Standard Magill	Orally Direct Vision	7 d.	Hoarseness	Unilateral (R)	Removal under G.A.	—
7	48	F.	Nasal Operation	15 mins.	+	Magill 10	Orally Direct Vision	56 d.	Sensation in throat	Bilateral Pedunculated	Removal under G.A.	—
8	39	F.	Sub-mucous resection	N.S.	N.S.	Standard Magill	N.S.	84 d.	Hoarseness	Bilateral Pedunculated	Removal under G.A.	—
9	46	F.	Fenestration	N.S.	+	Standard Magill	Orally Direct Vision	84 d.	Dysphonia	Unilateral (R)	Removal under G.A.	—
10	40	F.	Nasal Polypectomy	20 mins.	—	Standard Magill	Orally Direct Vision	28 d.	Hoarseness	Bilateral Sessile	Removal under L.A.	—

*N.S.—Not stated.

The vocal processes of the arytenoids can be traumatized by an endotracheal tube in one or two ways: either directly during the induction of intubation, or indirectly by static pressure of the tube *in situ*. In the reviewed literature there is a definite history of difficult intubation in 10 cases only. Furthermore, numerous cases are recorded here following intubation performed without difficulty under direct vision and with the aid of muscular relaxants. This would appear to minimize the role of direct trauma and emphasize the importance of static pressure as a main causative factor.

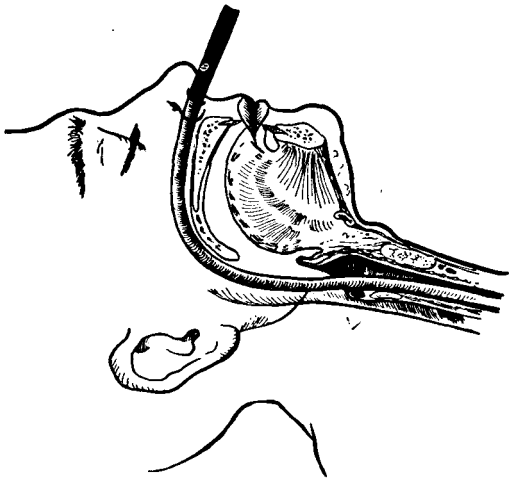


FIG. 1.

Diagram indicating the position of the flexible endotracheal tube in the glottis in sagittal section. (Note its location posteriorly.)

A variety of tubes have been used in intubation and the now popular resilient Magill tube was introduced in 1938. The conventional Magill tube is curved in one plane only, so that when *in situ* its natural springlike action causes it to exert pressure posteriorly in the larynx and also on the anterior tracheal wall. This has been confirmed by studies on the cadaver by Dwyer (1949). R. T. Barton (1953) has clearly demonstrated the position of the flexible tube in the glottis in the living state and has established the difference between this position and that assumed by the rigid bronchoscope which lies against the anterior commissure removed from the contact with the vocal process. Figures 1 to 4 reproduced by kind permission from his paper, demonstrate this. This observation incidentally explains why intubation granuloma has never been recorded as a sequel to bronchoscopy, a fact which has hitherto been difficult to explain. It follows from Barton's observations that excessive flexion of the head with the tube *in situ* will increase the pressure of the tube posteriorly in the larynx.

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Intubation Granuloma

The duration of surgery might be expected to influence the development of intubation granuloma and Finer (1948) believes prolonged



FIG. 2.
Diagram showing the endotracheal tube in the glottic chink as visualized from above. The tube can be seen against the posterior commissure pinched by the vocal processes.

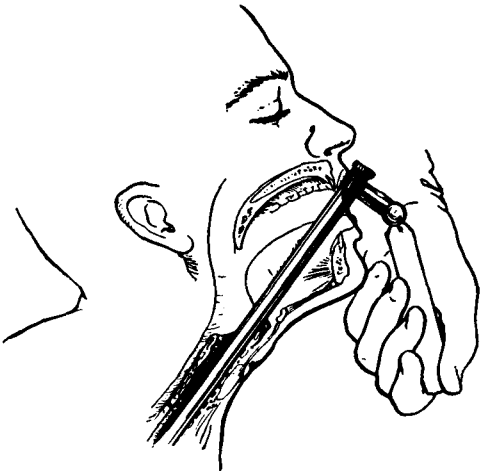


FIG. 3.
Diagram indicating the position of the rigid bronchoscope in the glottis in sagittal section. (Note its location anteriorly.)

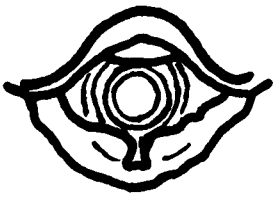


FIG. 4.
Diagram showing the bronchoscope in the glottic chink as visualized from above. The tube can be seen against the anterior commissure from the vocal processes.

anæsthesia to be a predisposing factor. Figure 5, however, demonstrates the time factor to be unimportant.

A pre-existing laryngitis has been blamed but this was found in only one case out of a large number in which pre-operative laryngoscopy was

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performed. On general principles, however, it would seem reasonable to agree with Simson Hall (1946) that the hyperæmic vocal process is more susceptible to injury than a healthy one.

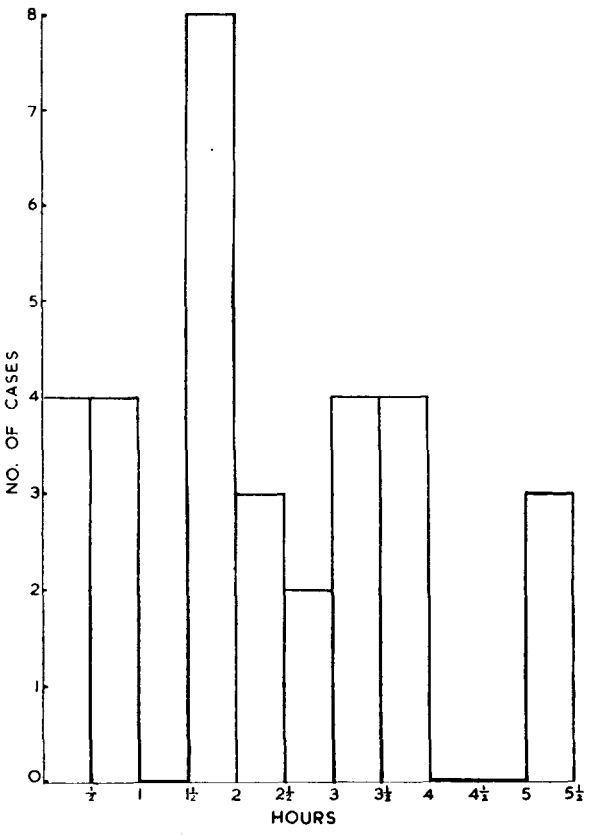


FIG. 5

Frequency distribution graph relating Time Factor to Case Incidence. (The figures are based on the combined data of the Reviewed Literature and the cases reported by the authors)

Pathogenesis

The vocal process of the arytenoid consists of a mucoperichondrium firmly adherent to underlying cartilage with no subjacent sub-epithelial connective tissue layer. The whole vocal process is thus a rigid unit and there is no mobility of the epithelium on underlying structure. An abrasion on the vocal process irrespective of whether it arose from induction trauma or pressure necrosis may result in the formation of an ulcer which by analogy with the ulcer described by Jackson (1935) can be designated "Intubation Contact Ulcer". The size of this ulcer can vary from the microscopic to one easily visible on indirect laryngoscopy. Bare

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cartilage will probably be exposed in the base of the ulcer with a consequent perichondritis. The bare base of the ulcer gradually becomes covered by non-specific granulation tissue. Constant trauma from contact with the opposite vocal process and possibly also an infective element, may tend to produce exuberant granulation tissue which becomes epithelialized and presents as a sessile granuloma. Subsequent fibrosis produces healing in a centripetal fashion narrowing the base until pedunculation occurs. The healing process can develop to a stage at which the base is so narrowed that auto-amputation follows, resulting in the

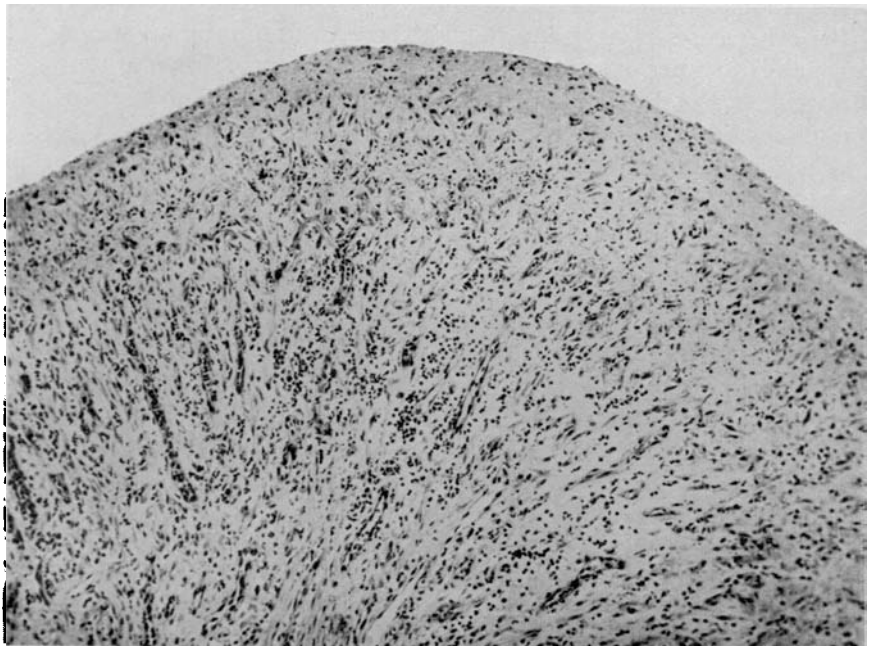


FIG. 6.
Biopsy of intubation granuloma showing non-epithelialized highly vascular granulation tissue covered by a layer of necrotic debris. × 120.

spontaneous expulsion of the granuloma—as noted in two cases in Table I and one case in Table II.

It is thus apparent that abrasion of the vocal process, "Intubation Contact Ulcer", sessile granuloma and the pedunculated granuloma are successive stages in the ultimate pathogenesis of intubation granuloma.

Histology

The structure of the intubation granuloma is simply that of non-specific granulation tissue epithelialized to a varying degree (Fig. 6). There is no justification for the application of the histologically ill-defined term "Granuloma Pyogenicum" to this condition.

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Case Reports

The salient points of 10 unpublished cases, seen by the staff of the Royal National Throat, Nose and Ear Hospital, London, between 1948 and 1956, are presented here (Table II).

A few of these cases were referred to the staff of this hospital following surgery elsewhere. Some of the data are incomplete as records of duration of anæsthesia, details of the nature of intubation, etc., are rarely recorded as a routine procedure.

In three of the cases reported here in which there was no history of direct trauma, the period of anæsthesia was 30 minutes or less. In many of the other cases reviewed, although there was no duration stated, it is reasonable to infer from the nature of the surgery that the period of intubation was relatively short. This accords with our previous conclusion, discussed above, based on an analysis of the literature.

The longest latent period of our cases varied from one to 32 weeks. Six cases were unilateral and 4 bilateral.

Symptoms

Hoarseness is the presenting symptom in the majority of cases. Respiratory obstruction can, of course, occur if the granuloma is large and especially if bilateral. Emergency removal may be necessitated on this account.

Diagnosis

The diagnosis of this condition is easily made in a patient who presents with persistent hoarseness following surgery.

The site of the lesion on the vocal process of the arytenoid is common to granulomata of the intubation and contact ulcer varieties. Contact ulcer granulomata are, however, invariably found in men with a history of "throaty phonation" and there is no record of previous intubation.

Prophylaxis

Prophylactic measures, the importance of which is debatable, include intubation under direct vision with the smallest possible size tube, use of muscular relaxants, avoidance of too light a plane of anæsthesia during induction, and prevention of excessive flexion of the neck during surgery. There is little doubt that the conventional Magill tube by virtue of its natural shape and resilience must in the final analysis be held responsible for pressure necrosis in the region of the posterior commissure and occasionally on the anterior tracheal wall. Dwyer (1949) strongly recommends a tube curved in two planes to achieve greater conformity with the natural shape of the air passages.

As intubation granuloma originates from an abrasion of the vocal process there is little doubt that early recognition of post intubation

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laryngeal damage will minimize the risk of subsequent granuloma formation. Hoarseness persisting more than two days after surgery in which intubation was performed is a clear indication for laryngoscopy. Should there be any ulceration of the vocal process, absolute vocal rest instituted until complete healing occurs is probably the most important single factor in the prevention of intubation granuloma.

Treatment

Removal of a sessile intubation granuloma exposes a large bare area which will gradually heal by granulation, possibly with recurrence of granuloma formation. Once centripetal healing has narrowed the base of the granuloma producing pedunculation, removal at this stage will not be followed by tendency to recur. Provided the airway is adequate, removal should, therefore, be deferred until pedunculation occurs. Removal with simple cup forceps is the method of choice. The use of cautery invites intractable perichondritis as bare cartilage lies at the base of the ulcer. Following removal absolute vocal rest must be instituted until healing has occurred.

Summary

The literature of intubation granuloma has been reviewed and 10 new cases presented.

Evidence is offered to incriminate the role of static pressure rather than direct trauma as the most important aetiological factor. Early investigation and treatment by vocal rest of post intubation hoarseness may prevent subsequent development of intubation granuloma.

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