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Obstructive endotracheal lesions of thyroid cancer

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Abstract

Airway invasion is a life-threatening complication of thyroid cancer. An important issue that deserves better attention is the differentiation between the clinical features of tracheal wall invasion *versus* those of an obstructive endotracheal lesion. We present information on the clinical course, diagnostic modalities utilized, management instituted, along with the prognosis, and follow-up data on a group of patients presenting with obstructive endotracheal lesions of thyroid cancer. Two thousand four hundred and eighty-nine thyroid cancer patients were seen at our institution from December 1975 to May 2000. Thirteen patients presented with symptoms of respiratory distress related to obstructive endotracheal lesions. At presentation, 11 patients underwent endoscopic examination. Imaging studies consisting of I^{123} whole body scan (WBS), computed tomography/magnetic resonance imaging (CT/MRI) of neck and chest, whole body positron emission tomography using 18-fluoro-2-deoxy-D-glucose (^{FDG}PET) were done, as also was determination of the tumour markers, serum thyroglobulin (TG) and calcitonin. Patients were followed for one to 108 months after the initial presentation. Intraluminal tracheal obstruction was severe in eight patients; five had near-total-occlusion. Paralysis of the vocal folds was present in five. Evidence of metastatic disease was present in most patients. Dissociation between iodine uptake and TG synthesis was evident in five patients during follow-up. Four patients died of cancer. Of the nine living patients; cancer persisted in six, recurred in two patients, and remitted in one. This study has identified obstructive endotracheal lesion of thyroid cancer as a distinct entity apart from tracheal wall disease. These data provide evidence that intraluminal tracheal invasion of thyroid cancer is an ominous sign and a frequent cause of morbidity.

Key words: Thyroid Neoplasms; Trachea; Neoplasms; Invasiveness

Introduction

Airway invasion by thyroid carcinoma occurs in one to 13 per cent of patients,[1,2] but an incidence of 41 per cent has been reported.[2] These differences may represent a selection bias. Airway involvement is recognized as an independent survival factor.[3] The morbidity and mortality is considerable, with a five-year survival of 70–80 per cent.[4] In nearly 90 per cent of fatal cases of differentiated thyroid cancer, locally active disease accounts for the mortality, principally due to airway obstruction.[5] The control of locally invasive disease is an important clinical problem and a therapeutic challenge. A thorough understanding of the natural history of tracheal invasive disease, the patterns of invasion, the diagnostic and the therapeutic modalities that are currently used, along with the availability of follow-up data, are crucial for improved management strategies.

A critical issue that deserves attention is the distinction between the clinical presentation of tracheal wall invasion *versus* an obstructive endotracheal lesion of thyroid cancer. A study of 2000 cases of thyroid cancer from the Mayo clinic reported the intraluminal involvement of larynx and trachea as a rare event, occurring in 0.9 per cent; only a single case in that series had an obstructive endotracheal lesion.[6] A recent report of 563 cases of thyroid cancer identified five per cent (28 cases) with aerodigestive tract invasion but none had a clearly defined obstructive endotracheal lesion.[7] When thyroid cancer presents as an obstructive endotracheal lesion, the prognosis is grave and life is acutely threatened.

We report here the clinical features, diagnostic modalities utilized, treatment instituted, along with prognosis and follow-up data of 13 patients with thyroid cancer presenting as obstructive endotra-

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cheal lesions in some of whom acute life-threatening complications developed. This report highlights the need to evolve strategies that will facilitate diagnosis and optimize the management of these patients.

Patients and methods

King Faisal Specialist Hospital and Research Centre (KFSHRC) provides tertiary care for cancer patients in the Kingdom of Saudi Arabia. Of 41 578 cancer patients seen from December 1975 to May 2000, thyroid cancer accounted for 2489 (5.9 per cent) cases; differentiated thyroid cancer was documented in 84.3 per cent (papillary cancer 80 per cent and follicular cancer 4.3 per cent). The present study was carried out on 13 patients; seven of these were previously diagnosed and treated for differentiated thyroid cancer (Table I). Only those patients who presented with obstructive endotracheal lesions associated with symptoms of suffocation, haemoptysis, or respiratory failure, were included in the study. Other symptoms (cough, hoarseness of voice, stridor, and dysphagia) were also present. Paralysis of the vocal folds was present in five patients. Patients met the following criteria at presentation: endoscopic documentation of an obstructive endotracheal lesion (performed in 11 patients) and transendoscopic biopsy of the lesion for histological documentation (performed in 11 patients) whenever it was feasible, performance of at least one imaging study, e.g. I^{123} whole body scan (WBS), computed tomography/magnetic resonance imaging (CT/MRI) of neck and chest, whole body positron emission tomography using 10 mCi (370 MBq) 18-fluoro-2-deoxy-D-glucose (^{FDG}PET); determination of the tumour marker, serum thyroglobulin (TG), on or off L-thyroxine suppression and calcitonin as applicable (as a measure of the disease activity), and availability of follow-up data.

Results

Course prior to presentation as obstructive endotracheal lesions (Table I)

Seven patients (2, 4, 5, 6, 10, 12 and 13) had been diagnosed previously and treated for thyroid cancer, either elsewhere or at our hospital and followed for six to 96 months prior to the diagnosis of obstructive endotracheal lesions. They had advanced disease at initial presentation; mediastinal involvement was present in four and tracheal/paratracheal invasion in two patients. Subtotal-thyroidectomy (STX) was performed in four patients, and STX with tracheostomy had been performed in two other patients at the referring hospitals. All patients received L-thyroxine suppressive treatment. All histological material was retrieved and reviewed at KFSH and RC. Regarding the primary thyroid cancer, patients 4 and 13 had follicular carcinoma, patient 7 had medullary thyroid cancer (MTC), and all the others had papillary carcinoma. Two patients (10 and 11) had the tall-cell variant of papillary cancer (a histological variant that is associated with poor prognosis). In patient 1, the primary thyroid tumour had foci of poorly differentiated cancer and patient 2 with anaplastic degeneration of the endotracheal obstructive lesion had a focus of squamous metaplasia without any transition to anaplastic carcinoma. Four patients had the tumour extension into the peri-thyroidal fibrofatty tissues; there was vascular and lymph node involvement present in two patients. Post-operatively, I^{131} treatment was given to four patients and external radiation to three.

At presentation as obstructive endotracheal lesions

Clinical, endoscopic, and tissue diagnosis finding of obstructive endotracheal lesions (Table II). Endoscopic diagnosis of a large, vascular, obstructing mass lesion was made in the 11 patients; of these five (1, 2, 3, 9 and 10) had near-total tracheal obstruction. Paralysis of the vocal folds was present in five

TABLE I
CLINICAL COURSE PRIOR TO DIAGNOSIS OF ENDOTRACHEAL OBSTRUCTIVE LESIONS OF THYROID CARCINOMA

Case no.	Age* (yr)/Sex	Diagnosis of TC (Mos) prior to endotracheal obstruction	Prior treatment
1	53/M	0	Sternal split and debulking of tumour around the trachea, oesophagus, aortic arch and inonimate artery**
2	69/F	6	Near total thyroidectomy, Tracheostomy External XRT
3	67/M	0	None
4	50/F	84	Thyroidectomy, I^{131}
5	58/F	7	Thyroidectomy
6	47/M	45	Thyroidectomy, Tracheostomy, I^{131}
7	50/M	0	None
8	58/F	0	Partial left lobectomy, **Tracheostomy
9	50/F	0	None
10	59/M	67	Thyroidectomy X 2, I^{131}, External XRT
11	84/F	0	Inoperable, External XRT
12	69/F	96	Partial thyroidectomy, I^{131}
13	54/F	1	None

*Age at diagnosis of intraluminal mass
**Done within the preceding month

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TABLE II
CLINICAL, ENDOSCOPIC AND TISSUE DIAGNOSIS FINDINGS OF OBSTRUCTIVE ENDOTRACHEAL LESIONS

Case no	Clinical findings	Endoscopic findings	Histology of endotracheal lesion at presentation
1	Respiratory failure Haemoptysis Dyspnoea Dysphagia Neck Mass	95% obstruction of tracheal lumen by a 3 cm long vascular mass. Right vocal fold paralysis	Papillary
2	Acute respiratory collapse	Vascular tumour almost completely blocking tracheal lumen Bilateral vocal fold paralysis	Anaplastic
3	Respiratory failure Haemoptysis Dyspnoea	Near total occlusion of tracheal lumen. Right vocal fold paralysis	Papillary
4	Haemoptysis Dyspnoea	Large fungating friable bleeding mass, located above the carina obstructing both main stem bronchi	Not done
5	Haemoptysis Dyspnoea	Vascular tumour from right lateral tracheal wall blocking 1/3rd of tracheal lumen, Paralysis of right vocal fold	Papillary
6	Haemoptysis Dyspnoea	Vascular haemorrhagic lesion arising from posterior tracheal wall	Papillary
7	Respiratory failure Neck mass	Not done	Medullary*
8	Respiratory failure Dyspnoea Neck mass	Not done	Papillary*
9	Respiratory failure, Neck mass	Intratracheal tumour 5 cm below vocal fold down to 5th tracheal ring	Papillary
10	Respiratory failure Haemoptysis Dysphagia	Large intratracheal tumour; near-total tracheal obstruction	Anaplastic
11	Respiratory failure Haemoptysis	Large tracheal tumour, paralyzed right vocal fold	Papillary
12	Respiratory failure Haemoptysis	Tumour infiltrating tracheal lumen with 50% luminal obstruction	Not done
13	Respiratory failure, Dysphagia	Tumour mass occluding 70% of tracheal lumen	Follicular

*Histological diagnosis established following tracheal resection

patients. Biopsy of the intraluminal lesion was carried out in all but two patients. In patient 4 (with follicular carcinoma) a tissue diagnosis of the obstructive lesion was not possible because of the high probability of exsanguination as the large vascular, fungating, mass lesion was friable and bleeding, and its critical location at the carina was obstructing both main stem bronchi. Tissue biopsy revealed histological congruence of differentiated thyroid cancer/MTC with the initial diagnosis except in patient 2 and 10 whose initial papillary carcinoma had undergone anaplastic degeneration by the time it presented as an endotracheal lesion.

Imaging and serological studies (Table III). CT scans of neck/chest were performed in all, I^{123} WBS in all except patients 2 (anaplastic degeneration) and 7 (MTC), PET scans in four patients, and MRI in two. The imaging studies documented obstructive endotracheal lesions in all patients who underwent CT,

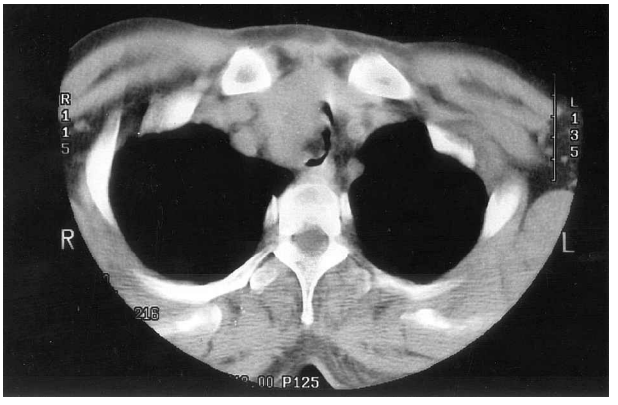

FIG. 1

CT scan of the chest; patient 1, (without contrast enhancement) at the level of the sternal notch shows near-total occlusion of the tracheal lumen by a large tumour extending from the right lobe of the thyroid.

FIG. 2

CT scan of neck; patient 2, (without contrast enhancement) shows a large paratracheal thyroid cancer invading and occluding the tracheal lumen.

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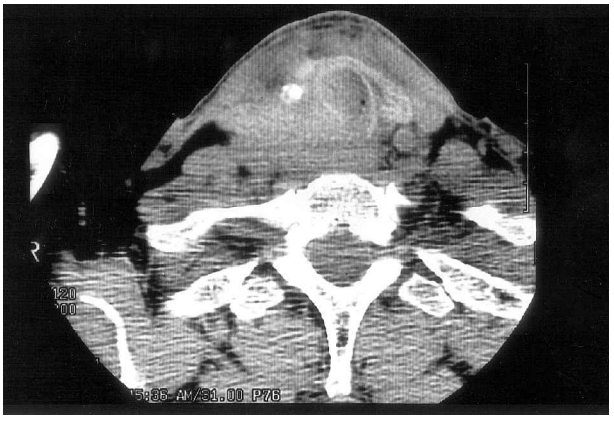
PET, or MR scans (illustrative cases are shown in Figures 1–5); additionally these studies helped define the extent of the primary and residual disease. The imagining studies detected thyroid remnant in patient 8, and intact glands in 1 (Figure 1), 3 (Figure 3a), 9, 11 and 7 (Figure 5) who presented with an obstructive endotracheal lesion. Mediastinal involvement was evident in six patients and pulmonary metastases in four at presentation. TG was determined in all differentiated thyroid cancer patients (four patients while on thyroxine L-T4 therapy, and off L-T4 in the others; TG off L-T4 treatment is considered to be a more reliable indicator of disease activity). It was increased in all (range 18–1600 μg/L) regardless of L-T4 therapy. Serum calcitonin was increased to 55 600 pg/ml in patient 7.

Treatment and follow-up (Table IV)

Patients with near-total tracheal obstruction. Five patients (1, 2, 3, 9 and 10) with near-total tracheal obstruction required emergency resuscitative measures consisting of tracheostomy/endoscopic tumour debulking. Patient 1 with acute respiratory failure due to severe (95 per cent) luminal obstruction required intensive care management because of rapidly worsening hypoxaemia (PO_2 40 mmHg). Patient 2 presented with acute respiratory collapse due to a near-total obstruction by a large, bleeding tumour mass.

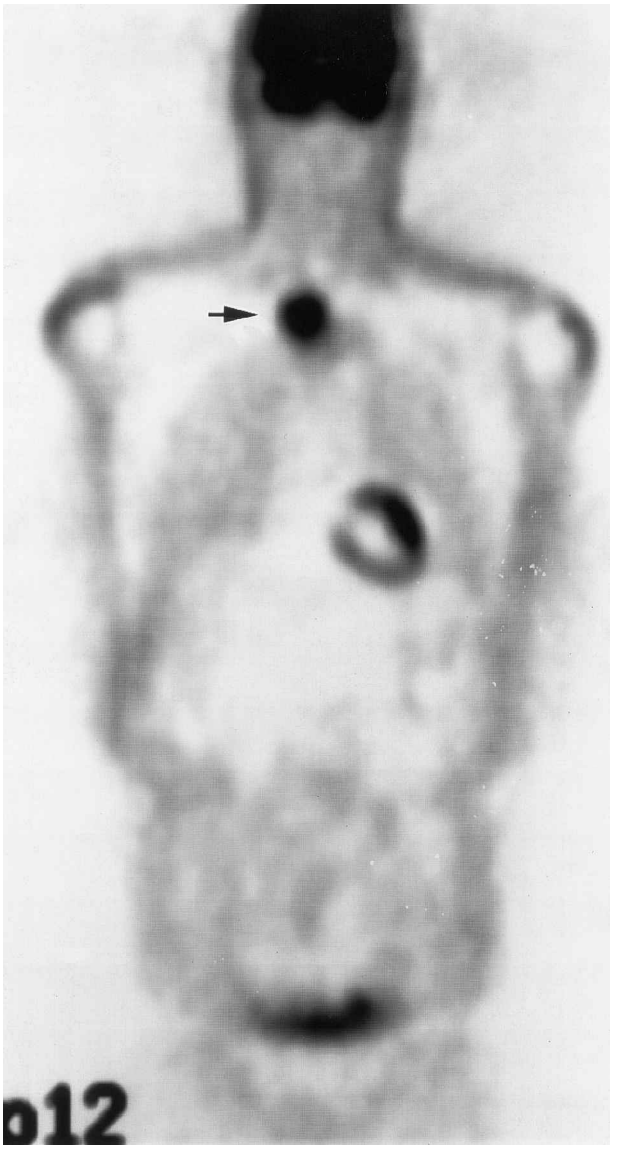
Their follow-up treatment consisted of thyroidectomy followed by I^{123} Rx in one patient (3), I^{131} and external radiation (XRT) in one (9 for tumour recurrence) and XRT alone in 1 and 2; patient 2 declined I^{123} Rx). Patient 10 with anaplastic transformation was not able to receive further treatment since he died within a month of presentation.

Patients with less than near-total tracheal obstruction (n = 8 patients). Two patients (7 and 8) underwent tracheal resection with end-to-end anastomosis, near total thyroidectomy and bilateral neck dissection. The post-operative course was complicated by the dehiscence of the anastomosis with subcutaneous



(a)

(b)



(c)

FIG. 3

(a) CT neck; patient 3, (without contrast enhancement) shows almost total occlusion of the tracheal lumen from an extensive infiltration by the thyroid cancer. The tumour originated in the right lobe, extended into the thyroid bed, posteriorly towards the oesophagus and to the anterior aspect of the cervical spine. (b) MRI of the neck (without contrast enhancement) shows an infiltrating thyroid carcinoma with intraluminal invasion of the trachea (upper arrow); the tumour surrounds and extends distal to a pre-existing tracheostomy (lower arrow). (c) A whole body PET scan shows persistent mediastinal tumour (arrow).

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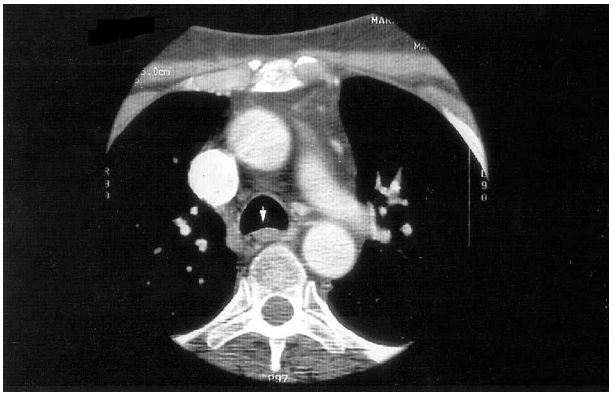

(a)

(b)

FIG. 4

(a) CT scan; patient 6 (with contrast enhancement) shows persistent thyroid tumour (arrow) in the lower trachea. (b) A whole body PET scan performed 40 days following withdrawal of L-thyroxine, shows a single focus of uptake of 18-fluoro-2-deoxy-D-glucose in the midline (arrow) corresponding to the location of the tumour seen on the CT scan.

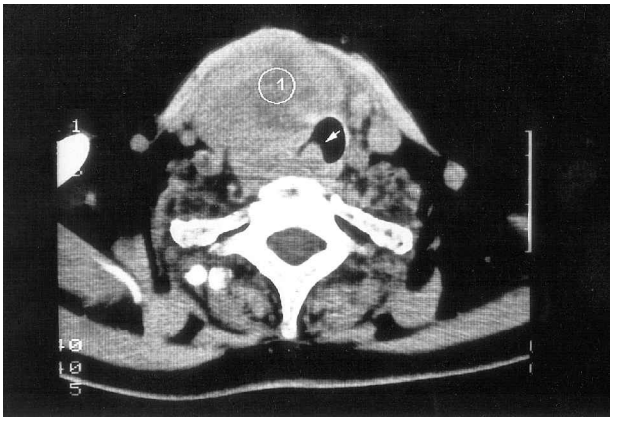

FIG. 5

CT scan neck; patient 7 (without contrast enhancement) shows a large medullary thyroid carcinoma with endotracheal invasion (arrow).

emphysema requiring re-establishment of the tracheostomy in patient 7 who had a 5.5 cm long tracheal resection. He is scheduled to receive external radiotherapy (XRT) and patient 8 has completed this treatment. Five patients (4, 5, 6, 12 and 13) received I^{131} and/or XRT and the remaining patient (11) died only a month following presentation (Table IV).

Follow-up data (Table IV). Patients were followed for one to 108 months after the initial presentation and for one to 85 months following the diagnosis of obstructive endotrachel lesion. Death directly and reasonably ascribed to the malignancy itself occurred in four patients. Patients 2 and 10 died of anaplastic degeneration of a pre-existing papillary carcinoma. Patient 4 developed diffuse metastatic disease involving lungs, mediastinum, skeleton and brain. The pulmonary and brain lesions did not take up I^{123}. Brain involvement caused extensive right hemispherical stroke and was seen as multiple haemorrhagic lesions of both cerebral hemispheres on CT scan. She received whole brain XRT. Vertebral metastases occurred preterminally, requiring XRT and fixation with a Harrington rod. Two patients who had tall-cell variant PC developed an unusual complication of pleural metastases (documented cytologically) preterminally. Nine patients are alive with evidence of persistent disease in six patients (examples are shown for patient 3 (Figure 3c) and 6 (Figure 4), recurrent disease in one and remission in two.

Dissociation between iodine uptake and TG synthesis, i.e. negative findings on I^{123} WBS with abnormal TG levels, was seen in five patients (4, 6, 10, 12 and 13) during follow-up. The pulmonary and brain lesions did not take up I^{123}, yet the TG remained abnormal (170–1600 μg/L) in patient 4. Patient 6 has a persistent tracheal lesion both on the CT and PET scans (Figure 4), despite having received I^{131} and XRT therapy previously. He has abnormally increased TG (235 μg/L) and a negative

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TABLE III
IMAGING AND SEROLOGICAL STUDIES

Case no.	Imaging Findings CT	PET	I^{123} WBS[1]	Serological findings TG (μg/L)	TSH mlU/
1	Mass from thyroid filling tracheal lumen, Paratracheal mass	ND[2]	Uptake both lobes, Cold nodule left lobe	18	2.6
2	Large tracheal and paratracheal tumour. Right pulmonary nodules	ND	ND	65	91
3	Complete tracheal occlusion by right thyroid lobe tumour. Mass also involving common carotid artery. Pulmonary nodules[3]	Uptake in right thyroid lobe and superior mediastinum	Cold nodule right thyroid lobe	401	1.0
4	Large carinal mass	ND	Mediastinal uptake	1600	42
5	Superior mediastinal extension of thyroid mass infiltrating the trachea[3]	ND	3 neck foci	34	139
6	Intra-tracheal lesion	Midline uptake[4]	No uptake	54	54
7	Large thyroid mass encircling trachea with intraluminal invasion and extending into the mediastinum	ND	ND		
8	Left thyroid lobe mass; 3 cm. Long tracheal lumen infiltration	ND	Right lobe and partial left lobe intact	23	5.3
9	3 × 2.5 cm mass left lobe; smaller right lobe mass	ND	Uptake both lobes cold nodule right lobe	46	5.9
10	Thyroid tumour involving tracheal lumen and oesophagus	Uptake thyroid bed, neck nodes and lung hilum	No uptake	159	73
11	Right thyroid lobe tumour invading trachea, multiple pulmonary nodules	ND	'Cold' right lobe	160	317
12	Residual tumour, left neck and upper mediastinal	Neck and right lung uptake	No uptake	55	132
13	Large goitre extending into mediastinum, 2 noduels projecting into tracheal lumen	ND	Cold nodule right lobe	446	2.0

[1]Whole body scan; [2]ND = Not done; [3]MRI showed similar findings; [4]Corresponding to the lesion on the CT

I^{123} WBS at last follow-up. For this reason the patient received 200 mCi of I^{131} but no radioiodine uptake was detected on the post-ablation WBS.

Discussion

We have characterized important features in patients with thyroid carcinoma who presented with life-threatening complications of an obstructive endotracheal lesion. There was airway obstruction in all patients, often associated with paralysis of the vocal folds. There was almost total obstruction of the lumen in five patients. The lesions were part of an advanced disease process that continued throughout the course of follow-up in all but two patients. The obstructive endotracheal lesions constituted an extremely advanced stage in the pathogenesis of tracheal invasion and carried a grave prognosis. Radiologically, encasement of the great vessels in the thorax/neck was evident, thus precluding total thyroidectomy and complete tumour debulking in some. Dissociation between iodine uptake function and TG synthesis was also observed. Histologically, the primary thyroid cancer was associated with features of poor prognosis; these consisted of perithyroidal soft tissue infiltration, vascular invasion and foci of poorly differentiated carcinoma along with squamous metaplasia. It is noteworthy that in two patients, the tumour became grossly undifferentiated with frank anaplastic changes by the time it invaded the trachea. Histological findings of dedifferentiation have been reported to be more frequent in patients with airway invasion. Tsumori *et al*. found that 50 per cent of the papillary and follicular cancers with airway involvement showed poor differentiation compared with 11.4 per cent without such involvement.[8] Another study by Namori *et al*. contrasted histological features in 45 patients with tracheal infiltration by thyroid cancer against 50 non-infiltrating thyroid tumours as controls.[9] Cases with tracheal infiltration showed features of significant nuclear atypia more than the controls; these characteristics were even more pronounced in 12 cases of recurrent disease with tracheal infiltration. Bayles *et al*.[7] reported 28 cases (five per cent) of invasive aerodigestive tract involvement from among 563 cases of thyroid cancer but none had clearly defined obstructive endotracheal lesions. Of the 13 patients with poorly differentiated cancer, 11 had anaplastic cancer. We

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TABLE IV
TREATMENT OF ENDOTRACHEAL LESION AND FOLLOW-UP DATA

Case no.	Treatment	Follow up Data Duration (Mos) Since Initial Presentation	Follow up Data Duration (Mos) Since Tracheal Obstruction	Alive/ Dead	Tumour Status at Last Follow-up
1	Bronchoscopy Tracheostomy External XRT	4	4	Alive	Endo-tracheal and mediastinal disease persists
2	Endoscopic debulking with emergency XRT	7	1	Dead	Large mediastinal tumour
3	Bronchoscopy Tracheostomy Thyroidectomy, I^{123}	15	15	Alive	Persistent neck and mediastinal tumour
4	Bronchoscopy External XRT	96	12	Dead	Mediastinal, Pulmonary, brain and spinal metastasis*
5	Bronchoscopy, I^{131}	22	15	Alive	Neck Recurrence
6	Bronchoscopy, I^{131} External XRT	71	26	Alive	Persistent tracheal tumour
7	Thyroidectomy, Bilateral neck dissection; Tracheal resection and end-to-end anastomosis	2	2	Alive	Persistent thyroid tumour
8	Total thyroidectomy Tracheal resection and end-to-end anastomosis External XRT	11	11	Alive	Remission
9	Bronchoscopy Tracheostomy, I^{131} and external XRT	85	85	Alive	Remission followed recurrence
10	Tracheostomy, chest tube drainage	68	1	Dead	Pulmonary and pleural metastasis*
11	Tracheostomy, Endoscopic tumour debulking	1	1	Dead	Large right lobe tumour, pulmonary and pleural metastasis
12	Tracheoscopy, completion thyroidectomy, External XRT	108	12	Alive	Persistent mediastinal tumour*
13	Thyroidectomy, tracheoscopic tumour debulking, I^{131}, External XRT	26	25	Alive	Persistent non-localizable tumour*

*Scan negative and TG positive

agree with Bayles *et al.*[7] that it is possible that infiltrative tracheal disease may represent a potentially more aggressive disease than that found incidentally adherent to the trachea at surgery. Our experience also suggests that the presence of tracheal invasive disease should raise the concern for undifferentiated thyroid cancer. Pre-operative fine-needle aspiration biopsy should be considered to exclude anaplastic cancer and to plan appropriate surgical resection.

Airway invasion by thyroid cancer is not uncommon; however, an obstructive endotracheal lesion posing a life-threatening situation is, fortunately, extremely rare. In a large series of 597 patients undergoing thyroidectomy for thyroid cancer, 40 were found to have laryngotracheal involvement without an obstructive endotracheal lesion.[10] Intraluminal involvement of the larynx and trachea by thyroid cancer is rare with an incidence of 0.9 per cent.[6] Of the 2000 cases of thyroid cancer seen at the Mayo Clinic from 1913 to 1973, there were 18 cases of intraluminal laryngotracheal cancer. Thyroid mass lesions were detected in the subglottis in 10 patients and only a single patient had an obstructive endotracheal lesion. Nine of the 18 patients with laryngotracheal lesions died within three years of treatment.[6] Two of the seven patients requiring tracheostomy for relief of airway obstruction died during the procedure.[6]

The management of cases reported here posed a therapeutic challenge, because of the presence of advanced disease of which obstructive endotracheal lesion was only a part. Our patients were managed by a multidisciplinary team experienced in the care of thyroid cancer patients. This consisted of a thyroidologist, an otolaryngologist, a thyroid surgeon, a nuclear medicine physician, an intensivist, a radiation oncologist, supported by an experienced histopathologist, and a radiologist. Emergency measures to restore the patency of the airways took precedence. Tracheostomy was lifesaving. Endoscopic biopsy was obtained for histological diagnosis before planning further management.

No consensus has been reached on the surgical management of thyroid cancer with tracheal invasion. Recommendations range from simple palliative procedures for grossly unresectable disease to total tumour removal sacrificing major upper aerodiges-

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tive tract structures.[2] End-block resection is recommended for intraluminal or full-thickness involvement of the aerodigestive tract.[7] Such an approach has been increasingly employed with acceptable morbidity[2,7,11] as was done in two of our cases. With reconstructive laryngotracheal surgery, functional and disease-specific outcomes appear to have improved.[7] A complete resection is favoured in order to improve local control as compared to the 'shave' procedure.[7,12] Generally, 5 to 6 cm of trachea is considered to be the limit of tracheal resection with primary anastomosis without complete tracheal and larygneal mobilization procdures.[2] Ishihara *et al.*[11] reported their aggressive surgical experience in 11 patients with thyroid cancer infiltrating the trachea; four patients had intratracheal/intrabronchial mass lesions.

Catastrophic events from tracheal invasion by thyroid cancer should be prevented and this involves adequate initial evaluation and surgery. Many patients may not receive adequate treatment before intraluminal invasion occurs. Ozaki *et al.*[12] have recommended that, whenever feasible, circumferential sleeve resection should be done to avoid carcinoma being left behind on the mucosa. They have demonstrated that once the carcinoma has invaded the submucosa, further extension into the trachea occurs circumferentially.

In cases of intraluminal invasion, imaging studies are essential to define the extent of the disease, and to plan the local and systemic management. CT scans can be helpful in determining the length of the involved segment and the size of the mass lesion. It has a high diagnostic accuracy in predicting invasion into the surrounding structures.[3] When CT demonstrates retrosternal extension, median sternotomy may occasionally be done to improve the exposure.[1] Of the 13 patients reported here sternotomy was carried out in a single patient (1) who had retrosternal extension of the tumour surrounding the trachea, oesophagus, aortic arch and the inominate artery. An advantage of MRI is the large-field images in different planes which define the structures of the neck and the cervicothoracic junction. In our patients the obstructive endotracheal lesions were very well defined by CT and MRI. The experience with PET scans is limited; its role in the diagnosis of thyroid cancer in general, and endotracheal invasion in particular, is yet to be determined. We found it helpful in the detection and localization of persistent thyroid cancer in the difficult-to-diagnose iodine-negative and TG-positive cases.[13] Of particular interest, was the detection of the obstructive endotracheal lesion by PET scan (Figure 4) in one of our patients in whom the iodine scan was negative and the TG was abnormal.

A better understanding of the natural history of thyroid cancer with endotracheal invasion, the patterns of such invasion, and the diagnostic and treatment strategies, is essential for improved management. It is probable that endotracheal invasion begins with involvement of the superficial structures of the trachea occuring both longitudinally and circumferentially. These different patterns of involvement have been used to categorize the prognosis and the extent of surgical resection.[12] Indeed, Shin *et al.*[14] have devised a new staging system based on the anatomic manner of tumour extension to the trachea. They report a poorer prognosis when the tumour extends through the entire thickness and expands the tracheal mucosa. It has been proposed that tracheal invasion occurs as a result of extension from metastatic tumour in a peritracheal lymph node rather than direct extension from the primary thyroid cancer.[3] This has been refuted by Shin *et al.*,[14] who have demonstrated that the tracheal invasion occurs directly from the primary thyroid cancer. They found that the lymphatic channels connecting the thyroid and the trachea are small and rarely plugged with microscopic tumour. The presence of potential lines of weakness in the tracheal wall where the vessels penetrate perpendicular to the lumen, allows pathways of invasion by mechanical shearing forces.[14] Thyroid carcinoma with tracheal wall invasion, not yet involving the mucosa, has a relatively good prognosis and tracheal resection is worthy of consideration.[14] However, when the mucosa is invaded to an extent that the tumour becomes endoscopically visible, the prognosis is bad, regardless of the nature of surgery done.[14] Since haemoptysis is always the result of intraluminal invasion of thyroid cancer, this symptom carries a poor prognosis. Improvements in understanding these concepts would permit refinement in patient stratification and the construction of realistic management algorithms.

Obstructive endotracheal thyroid cancer is an indication for aggressive use of adjuvant therapy with I^{131} and XRT. Radioactive iodine should be used in patients with invasive thyroid cancer who demonstrate sufficient iodine uptake; it has been shown to reduce local recurrence significantly.[3] XRT is effective in controlling local/regional disease, especially in patients with incomplete resection, those with infiltrative disease, or in those with poor or no iodine uptake.[3]

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