COMMUNITY ACQUIRED BACTERIAL TRACHEITIS

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ABSTRACT

Objective: Determination of main causes of severe obstructive dyspnea (SOD) with emphasis on bacterial tracheitis.

Population and Methods: Hospital records of patients hospitalized for SOD from January 1986 to December 95 were reviewed. Diagnostic criteria for BT were clinical. Blood cultures and tracheal aspirates for culture were taken immediately after intubation and IV antibiotics initiated thereafter.

RESULTS: 202 cases of SOD were recorded including 171 laryngotracheobronchitis, 1 epiglottitis and 15 BT. 27 patients needed intubation including 3 LTB, 15 BT, and 1 epiglottitis. The age of BT patients ranged between 26 days and 13 years. Fourteen occurred in the cold season. All patients had signs of URTI 5-120 hours prior to admission. Respiratory distresses (inspiratory stridor +/- expiratory wheezes) and cyanosis were the main clinical features on admission. Drooling and hyperextension of the neck were absent. Twelve patients required immediate intubation, 3 intubated few hours later were initially diagnosed as reactive airway disease. Tracheal aspirates showed dense growth of *Staphylococcus aureus* in 6 , *Viridans Streptococcus* in 3, βhemolytic *Streptococcus Group* in 2 and *Haemophilus influenzae* in 4. Only one had a positive blood culture for *Streptococcus pneumonia*. Initial chest roentgenogram showed patchy infiltrates or bilateral hyperinflation. Fine mucosal irregularities of the trachea (lateral neck) were noted in 4. Assisted ventilation was needed in 8 patients for 4-120 hours. Frequent endotracheal aspirations were necessary in all cases during the first 24 hours. Extubation was possible after 24-144 hours. Two patients developed adult respiratory distress syndrome, one of them died.

Conclusion: BT is the main cause of SOD requiring intubation in this community. Epiglottitis is rare.

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INTRODUCTION

Epiglottitis and bacterial tracheitis are major causes of acute obstructive dyspnea. Both are capable of causing life-threatening upper airway obstruction. Bacterial tracheitis is considered rare when compared with epiglottitis but this assertion has not been verified in Mediterranean countries. Through a 10 years study we have tried to evaluate the main causes of severe obstructive dyspnea, with emphasis on clinical and bacteriologic characteristics of bacterial tracheitis.

MATERIALS and METHODS

Makassed Pediatric Department, located in a general hospital, was the referral pediatric center for a population of 600 000 Palestinians (Jerusalem surroundings and the southern area of the West Bank) during the period of the study. A special data sheet was introduced for all cases of acute severe upper airway obstruction admitted to the pediatric ICU through the emergency room since January 1, 1986. Cases of solid foreign body aspiration, caustic ingestion, bronchiolitis and bronchial asthma were not included. Routine investigations included; Chest X-rays, lateral and anteroposterior neck views (were obtained if the status of the patient permitted), blood cultures, and blood gas monitoring.

Table I: SEVERE OBSTRUCTIVE DYSPNEA 1986-1995

Pathology	N	ETT	Deaths
Laryngotracheobronchitis	171	03	01
Bacterial tracheitis	15	15	01
Hot beverage inhalation	04	02	00
Angioneurotic oedema	03	02	00
Tracheobronchial malformation	04	04	01
Ludwig angina	02	00	00
Retropharyngeal abscess	02	00	00
Epiglottitis	01	01	00
TOTALS	**202**	**27**	**03**

N=number, ETT=Endotracheal intubation

Endotracheal intubation was done if possible in the operating room after a careful direct laryngoscopy. In case of intubation tracheal aspirates were taken for bacterial studies immediately, no viral cultures were done.

Records from 1-1-1986 till 31-12-1995 were reviewed (Table I). This article focuses on the clinical, bacteriological and epidemiological aspects of bacterial tracheitis in this community.

Diagnostic criteria for bacterial tracheitis were: obstructive dyspnea requiring endotracheal intubation to maintain the airway and a gush of pus and a dramatic improvement of the respiratory distress after intubation. Three negative criteria were verified: absence of significant lung pathology, absence of a preexisting congenital tracheal malformation and absence of foreign body inhalation. In all cases direct laryngoscopy revealed a normal or mildly congested epiglottis.

RESULTS

Fifteen patients, 4 females and 11 males, were diagnosed to have bacterial tracheitis. Their mean age was 55.2 months, with a range of 26 days to 13 years (Table II). Fourteen cases occurred in the cold season (November to April) and one in June.

PRODROMAL PERIOD

Twelve hours to 5 days (mean 50.4 hours +/- 30) before admission all patients were reported to have signs of upper respiratory tract infection. Poor sucking and hypoactivity were the main family concern in cases 1, 2, and 3. History of fever during this period was reported in 12 patients. Respiratory distress and barking cough progressively increased later on in older children. Few hours before admission, voice modification was reported in 10 patients. Six patients had started a course of orally administered antibiotics less than 24 hours before admission.

Table II: CLINICAL PICTURE of BACTERIAL TRACHEITIS

	S	AGE	PPh	RD	BC	HV	AP	CA	SH	T
1	M	26d	48	G	-	-	-	+	-	37.5
2	M	30d	72	G	-	-	-	+	+	34.8
3	M	35d	48	G	-	-	-	+	+	33.5
4 *	M	4m	24	W	-	-	-	+	-	38.2
5	F	15m	72	IS,W	+	+	-	+	-	39.3
6	M	34m	48	IS	-	+	+	+	-	38.2
7*	M	38m	24	DAE	-	-	-	+	-	38.5
8	M	52m	24	DAE	-	+	-	+	-	38.5
9	M	5y	12	IS	-	-	-	-	-	36
10	F	6y	120	IS,W	-	-	-	-	-	37.8
11	F	6y	24	IS,W	+	+	-	+	+	37.8
12	M	7y	72	IS	-	-	-	-	-	38.5
13	M	10y	24	IS	+	-	-	+	-	39.1
14	M	10y	96	IS	-	+	+	+	-	36.5
15	M	13y	48	IS	+	+	-	-	-	37.8

AP: aphonia, BC: barking cough, CA: cyanosis, DAE: diminished air entry, G:gasping, HV: hoarseness of voice, IS: Inspiratory stridor, PPh: prodromal period in hours, T: Temperature, W:wheezing.

STATUS ON ADMISSION (Table II)

Respiratory distress and cyanosis were the main clinical features on admission. The youngest patients arrived gasping to the emergency room and 2 of them had unrecordable blood pressure. Two patients had cyanosis, shallow breathing and severely diminished air entry bilaterally.

In other cases inspiratory stridor alone or associated with expiratory wheezes was noted. One patient had expiratory wheezes and cyanosis. Six patients had hoarse voice, which was associated with aphonia in 4, and barking cough in 2. Patient 7 was in coma. Three patients were in shock. Ten patients had rectal temperature of 37.8 or more, and 2 were hypothermic. Drooling was absent in all cases. Spontaneous hyperextension of the neck was not noted in any case. Patient 5 had questionable neck stiffness but cerebrospinal fluid was normal. None of these patients had signs of immunodeficiency, malnutrition, chronic lung disease, and malignancy, measles or contact with measles cases. Patients 7 and 9 had mild mental retardation and patient 5 was operated at birth of type C esophageal fistula and done well after.

INITIAL MANAGEMENT

Nine patients; 1,2,3,6,7,8,11,12,14 required intubation in the emergency room or immediately upon arrival to pediatric intensive care unit because of severe cyanosis and bradycardia. Three patients 9, 13, 15, were intubated soon after admission in the operating room. The others 4,5,10 were intubated in the pediatric intensive care unit 1, 6 and 5 hours after admission. These 3 cases were initially diagnosed to have reactive airway disease and received subcutaneous adrenalin without benefit. In each case at the time of intubation, the epiglottis was described as normal or mildly congested. When the tube was inserted a copious amount (5 to 50 ml) of pus was obtained through the endotracheal tube. Intubation was followed by a dramatic improvement of the respiratory distress.

INVESTIGATIONS (Table III)

Blood gases were done in 11 patients before intubation. Eight patients had pH of 7.3 or less. Hypercapnia was noted in 9. Immediate Gram stain and samples for culture of tracheal aspirate were taken after intubation. Gram-stained smears obtained from 11 patients showed sheets of pus cells, mucus and fibrin filaments. Gram-positive cocci were seen in three patients and Gram-positive diplococci in 2 patients. In other cases the thickness of the preparation did not permit any definite conclusion.

Table III: INVESTIGATIONS

	WBC	BLOOD GASES		Ch.Rx	Gr.S	Tracheal culture	Blood culture
		pH	pCO_2				
1	13800	7.18	70	RLLI	I	S.A	No growth
2	8750	-	-	BH	I	H.I	No growth
3	6530	-	-	BI	I	S.A	No growth
4	16000	7.30	45	BH	G+d	H.I	No growth
5	14300	7.28	45	BI	G+c	S.A	No growth
6	11100	6.87	75	BI	I	S.A	S.pneumonia
7	11200	7.25	63	RI	I	St.V	No growth
8	15400	7.30	47	BH	ND	Bh.st.C	No growth
9	19200	7.O8	75	BI	G+c	Bh.st.A	No growth
10	31000	7.24	58	BH	ND	H.I	No growth
11	31000	-	-	BH	I	H.I	No growth
12	33000	7.40	28	BH*	ND	St.V	No growth
13	12280	7.37	45	BI	G+c	S.A	No growth
14	13500	7.48	31	BI	ND	S.A	No growth
15	12800	-	-	BI	G+d	St.V	No growth

BI: bilateral infiltrates, RI: Right sided infiltrates, BH: Bilateral lung hyperinflation, RLLI: Right lower lobe infiltrates, I:Inconclusive, ND: Not done, SA: *Staphylococcus Aureus*, HI: *Haemophilus influenzae*, St.V: *Streptococcus Viridans*, Bh.st.A,C:*βhemolytic streptococcus group A,C*, G+c: Gram positive cocci, G+dc: Gram positive diplococci.

Dense growth of *Staphylococcus aureus* was noted in 6 cases. *Viridans Streptococcu*s in 3, *β hemolytic Streptococcus*, Group A in 1, group C in 1 and *Haemophilus influenzae* was noted in 4 cases

Blood cultures were negative in 14. Only Patient 6 had a positive blood culture for *Streptococcus pneumonia*. White blood count revealed leukocytosis with many immature forms. Lateral neck radiograph was done in 9 patients and the epiglottis was normal. The anterior aspect of the trachea showed fine mucosal irregularities in 4 cases. Initial chest roentgenogram showed patchy infiltrates in 8 patients, bilateral hyperinflation in 6 and patient 1 had right lower lobe consolidation. Patients 1,2,3,5, had cerebrospinal fluid examination and cultures, all had normal results and negative cultures. Patient 7 was in coma on arrival with Glasgow coma scale 6/15. After stabilization he gained consciousness rapidly. His brain CT and cerebrospinal fluid examination were normal.

HOSPITAL COURSE and MANAGEMENT (Table IV)

After the initial few minutes of bagging with 100% oxygen, the tube was kept in place with FiO_2 around 40% and adapted later. Assisted ventilation was needed in 8 patients for a period of 4 hours to 5 days. Muscle paralysis was used only in patient 13 who resisted intubation. Frequent endotracheal aspirations were necessary in all cases during the first 24 hours. Airway humidification was very important to prevent inspissations of tracheal secretions, although one patient death was probably due to recurrent obstructions. Extubation was possible after 24 hours to 6 days. Patient 15 was extubated 48 hours after admission, but 4 hours later the respiratory distress worsened and he was reintubated for an additional 3 days. Endotracheal tube gets obstructed easily in the first few hours. Dexamethasone was used in 7 cases, mainly to alleviate signs of obstruction after extubation. Duration of steroidal treatment did not exceed 72 hours.

Initial antibiotic coverage consisted either of cloxacillin, 100 mg/kg/day, and chloramphenicol, 50 to 70 mg/kg/day, or ampicillin, 200 mg/kg/day, and cloxacillin. In the neonatal period the initial regiment was ampicillin and gentamicin. Treatment was modified later according to the organism cultured from the trachea. Antibiotics were given IV throughout hospitalization and then completed for 10 days orally at home.

COMPLICATIONS AND SEQUELA

During hospitalization patient 2 developed severe hyponatremia due to inappropriate ADH secretion.

Table IV: HOSPITAL COURSE AND COMPLICATIONS

	S	AGE	EI	IMV	ED	C	H S
1	M	26d	A	0	72	0	11
2	M	30d	A	2d	72	Hyponatremia	6
3	M	35d	A	5d	6d	AL/ARDS	14
4	M	4m	5h	3d	72	0	9
5	F	15m	1h	0	72h	Polypoid Formation	14
6	M	34m	A	0	72h	0	6
7	F	3y	A	3d	72	0	5
8	M	52m	A	0	48	0	5
9	M	5y	A	0	48	0	6
10	F	6y	5h	4h	72	0	10
11	F	6y	A	4h	24	0	10
12	M	7y	A	2d	48h	ARDS/AL/SH	D
13	M	10y	A	24h	36h	0	6
14	M	10y	A	0	24	0	3
15	M	13y	A	0	48/72	0	9

A: upon admission, AL: air leak, M: male, F: female, m: month, C: complication,
D: death, ED: endotracheal intubation duration, EI: Time of endotracheal intubation,
h: Hours, IMV: intermittent mandatory ventilation, ARDS: adult respiratory distress syndrome, S: Sex, SH: Shock.

Patient 3 developed adult respiratory distress syndrome and bilateral pneumothorax. This same patient underwent tracheobronchoscopy because of persistent dyspnea to rule out malformation and it showed inflammatory modifications and thick secretions.

One death (patient 12) occurred in this series. This patient was initially admitted in another hospital as a case of viral croup. He was referred few hours later to our hospital after he developed a generalized convulsion. A copious amount of pus was noted upon intubation in the emergency room. This patient had a severe course with recurrent obstructions due to inspissated secretions. He developed the next few hours severe distress and the chest roentgenogram showed modifications suggestive of adult respiratory distress syndrome complicated later by bilateral pneumothorax. He died of a second episode of shock 48 hours after admission. Pre and post mortem blood cultures remained negative.

Hospital stay ranged between 3 and 14 days. Two weeks after discharge, patients were seen in the outpatient clinic; their respiratory status was judged normal in thirteen cases. Patient 5 had persistent mild stridor and bronchoscopy revealed the presence of a small subglottic polyp formation, which was resected with good clinical outcome.

DISCUSSION

Bacterial tracheitis, actually described as a rare condition, was commonly reported as cases of non-diphteric laryngitis before 1940 (1, 2). Patients with influenza A_2 infection, severe croup, healthy epiglottis, tenacious secretions in the trachea and larynx who required tracheostomy were reported by Howard et al in 1972 (3). The clinical picture of these patients was very suggestive of bacterial tracheitis. Jones et al coined this term in 1979(4). Various terms such as membranous laryngotracheobronchitis (5, 6), pseudomembranous croup (7) had also been used. The number of reported cases increased since 1979 and two detailed reviews of about 150 published cases achieved the characterization of this disorder (8, 9). The disorder affected predominantly males, more commonly in winter, and mean age was between 4 and 5 years. Patients presented with acute respiratory distress after a prodrome of upper respiratory tract infection lasting few hours to few days. White blood cell counts varied over a wide range. Blood culture results were rarely positive and tracheal cultures commonly yielded *Staphylococcus aureus* or *Haemophilus influenzae* and rarely others bacterial agents (8, 9, 10, 11, 12, 13, 14, 15, and 16).

Infection with Parainfluenza virus (8,9, 17) respiratory syncytial virus (18) and measles (19,20) has been reported in association with secondary bacterial tracheitis. Susceptibility of patients with immune deficiency (13, 21), Down's syndrome (22), and patients with preexisting anatomic pathology in the airway like tracheomalacia (8) and repaired tracheoesophageal fistula (23) to develop bacterial tracheitis was noted. Complications included respiratory failure, toxic shock syndrome, anoxic encephalopathy, and death (8, 9,18,24,25, 26, and 27).

Few clinical clues may help in differentiating this condition from croup or epiglottitis. Usually viral croup does not have a progressive worsening course. A high suspicion index of bacterial tracheitis must be kept when approaching a child with a deteriorating general condition and increasing signs of respiratory distress following a picture of upper respiratory tract infection (28). The absence of drooling, neck hyperextension and the presence of cough were useful signs to distinguish this condition from epiglottitis. Drooling was noted in more than 50% of cases of epiglottitis, whereas the absence of spontaneous cough taken alone was the most sensitive predictor of acute epiglottitis in an another series (29). For others (13) reliable predictive factors do not exist for bacterial tracheitis. The only diagnostic procedure to distinguish bacterial tracheitis accurately and promptly from other forms of acute obstructive upper airway diseases was direct laryngo-tracheo-bronchoscopy.

Lateral neck roentgenograms are of pure academic interest in an emergency situation. Normal epiglottis and the presence of fine irregularities of the mucosa of the anterior aspect of the trachea with subglottic narrowing can be helpful in distinguishing epiglottitis from bacterial tracheitis in some situations (5, 6, and 8).

Regarding initial management we think that the well-established rules concerning the management of suspected epiglottitis must be respected as guidelines (30, 31, and 32). According to the clinical situation immediate intubation in the emergency room or in the operating room

must be done as soon as possible. From our observations an experienced pediatric ICU resident is not expected to face a major intubation difficulty even in the emergency room in cases of bacterial tracheitis. The supine position does not aggravate their distress and usually patients do not adopt the sitting position with neck hyperextension.
Antishock measures might be necessary in some cases on admission through the first 48 hours. Shock might recur and constitute a major risk of death (8, 9, 24, 25, and 27). Antibiotic treatment must initially cover *S. aureus*, *H. influenzae* and *streptococci*. Later on antimicrobial therapy should be guided by results of cultures and susceptibility testing.
Intubation alone will be probably sufficient without assisted ventilation in most cases. The major difficulty later is to keep the airway patent.

Frequent tracheal suction and humidification are essential to prevent inspissations and recurrent airway obstruction leading to cardiopulmonary arrest and neurological complications.

These series characteristics are generally in agreement with the reviewed series (8, 9). All cases were community acquired making bacterial tracheitis the predominant cause of life-threatening obstructive dyspnea of infectious origin in the studied population. The relative paucity of epiglottitis could not be explained by the incidence of H. influenzae infection (33). Anti-Haemophilus Influenza vaccination had only been used on very partial scale since the beginning of 1994; it is still early to appreciate the consequences of its introduction.

The population of the area served by our pediatric ICU has grown from 540 000 in 1986 to 800 000 in 1995. Knowing that 50 % of this population is less than 15 years old the age specific incidence for bacterial tracheitis would be at least around 1/200 000 per year for this age group. The incidence of epiglottitis is really negligible compared to the 14/100 000 reported from Sweden (34).

Sofer et al had reported their experience of severe obstructive dyspnea and bacterial tracheitis from the neighboring area of Beer Sheba (Israel). Their population has higher standards of life but bacterial tracheitis represented 10 of the 18 cases of infectious severe obstructive dyspnea, which required intubation during the 8 years of the study (35). Through personal communication with different pediatric departments in Jordan, Syria, Iraq and Lebanon our impression about the rarity of epiglottitis was generally shared but bacterial tracheitis is still an under-diagnosed and largely ignored entity.

From this 10 years study we concluded that bacterial tracheitis, although rare, is the most common cause of severe obstructive dyspnea in this area. Epiglottitis is really a rare entity. The consideration of bacterial tracheitis as the first differential diagnosis in cases of severe croup, suspicion of epiglottitis and even in some cases of severe reactive airway disease must be emphasized.

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