Oropharyngeal flora and chest infection after upper abdominal surgery

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Abstract

The oropharyngeal flora was determined before and after operation in 127 patients undergoing upper abdominal surgery. Swabs of the oropharynx were obtained on the day before operation and on the first, third, and fifth postoperative days. Isolation of *Haemophilus influenzae, Streptococcus pneumoniae,* and coliforms was noted. In the 108 patients with the full series of throat swabs the incidence of oropharyngeal colonisation by *H influenzae* was 16% and was unchanged after operation. *S pneumoniae* was present in only 5·6 (six patients) before operation and the incidence fell to 1·9% (two patients). There was a transient rise in coliform colonisation postoperatively. Twenty four patients developed a chest infection. In eight a bacterial cause was established, in six *H influenzae* and in two *S pneumoniae.* There was a significant relation between the carriage of *H influenzae* before operation and development of a chest infection. *H influenzae* was also found more often in cigarette smokers. The presence of *S pneumoniae* or coliform organisms before surgery was not related to the development of infection. The high incidence of postoperative chest infection in cigarette smokers appears to be due in part to preoperative colonisation of the oropharynx by *H influenzae.*

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The incidence of chest infection after upper abdominal surgery under general anaesthesia varies from 17% to 38%.[1–4] The bacteria most commonly concerned, particularly *Haemophilus influenzae,* may be part of the normal flora of the oropharynx.[5,6] If these organisms are aspirated during or after the operative procedure they will encounter the conditions of reduced clearance[7] and impaired host defences that allow colonisation. The presence of these potential pathogens in the oropharynx before operation might therefore be related to the development of postoperative chest infection. We tested this hypothesis by determining the oropharyngeal flora before and after operation in patients undergoing upper abdominal surgery and its relation to chest infection.

Methods

We studied 127 consecutive patients undergoing elective upper abdominal surgery during 12 months.

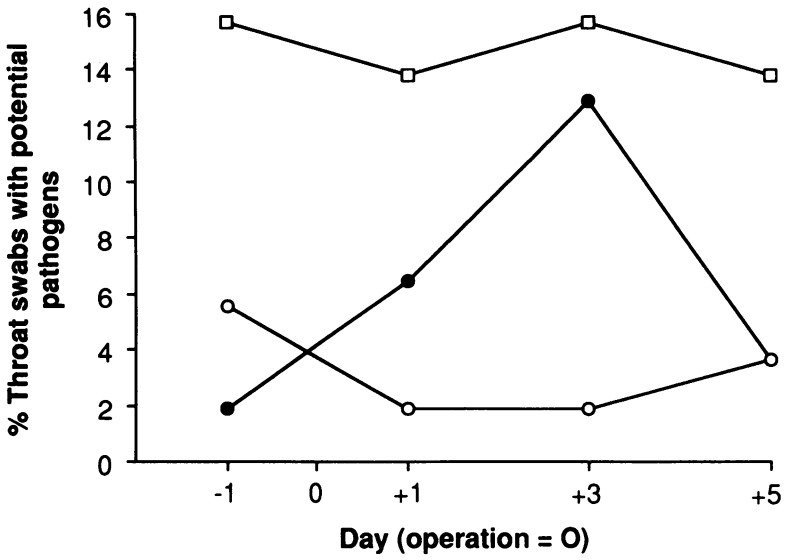
Throat swabs were obtained by sampling the pharyngeal mucosa bilaterally with the tongue depressed. Specimens were collected on the day before surgery and on the first, third, and fifth postoperative days. Over 90% of the swabs were taken by one individual (JPD) and the remainder by nursing staff using the same procedure. All swabs were inoculated directly on to the following media within 45 minutes of collection: blood agar, chocolate agar on which a bacitracin disc was placed or in which bacitracin (10 IU/ml) was incorporated,[8] and CLED (cysteine lactose electrolyte deficient) agar. All plates were incubated overnight at 37°C in a carbon dioxide incubator. Isolates were identified according to standard laboratory procedures. Pure or heavy growths of *H influenzae* and *Streptococcus pneumoniae* were noted.

Each patient was assessed clinically on the day immediately preceding surgery, on three of the four postoperative days, and on alternate days thereafter until discharge. The presence of cough, the degree of purulence of sputum, body temperature, and physical signs in the chest were recorded. A chest radiograph and the blood white cell count were also obtained when any of these symptoms or signs were present. Chest infection was diagnosed by the presence of four of the following features: fever, cough, purulent sputum, chest signs, leucocytosis, and radiographic change—except when there was purulent sputum, when only one other criterion was required (table 1).

Patients were defined as smokers (20 or more pack years) or non-smokers (less than 20 pack years). Preoperative spirometry was performed; airflow obstruction was defined as an FEV_1:FVC ratio below 70%. Chronic bron-

Table 1 Criteria for chest infection

	Criterion	*Points*
Temperature (oral)	>38·0°C >24 hours after operation	1
Cough	Developed or increased since operation	1
Sputum	Increase of two grades of purulence	3
Examination	Crackles	1
Chest radiograph	Change consistent with infection	1
White cell count	>11 × 10^9 g/l	1
Haemopytysis or sudden onset of symptoms (that is, possibility of pulmonary embolism)		−1
Total score of 4 or more points indicates chest infection 0–3 points indicates no chest infection		



Isolation of potential pathogens from the oropharynx before and after operation. —□— Haemophilus influenzae; —●— coliforms; —○— Streptococcus pneumoniae.

chitis was identified by production of sputum for three months of the year for two consecutive years.

Patients routinely received 1·5 g cefuroxime intravenously at induction of anaesthesia. Those patients undergoing gastric or colonic surgery also received 500 mg metronidazole intravenously.

Approval was provided by Frenchay District Ethics Committee and verbal consent was obtained from all patients.

ANALYSIS

The incidence of preoperative *H influenzae* and *S pneumoniae* colonisation and of coliform colonisation on the third postoperative day was related to the development of chest infection and to cigarette smoking by the χ^2 test with Yates's corrections.

Results

Of the 127 patients entering the study five patients declined to take part and 14 were excluded either because the full series of throat swabs was not obtained owing to early discharge (11 patients) or for other reasons (three patients). A full series of throat swabs from 108 patients was available for analysis.

There were 42 men and 66 women aged 18–87 (mean 56) years. The operations were as follows: biliary (77), colonic (19), gastric (11), and splenectomy (1). The duration of surgery varied from 0·5 to 4·5 (mean 1·14) hours. Thirty seven patients (34%) were smokers and 13 patients (12%) had chronic bronchitis or chronic airflow obstruction.

Preoperatively 17 patients (16%) were colonised by *H influenzae* and the incidence was similar after operation. No patients had *H influenzae* isolated from the oropharynx after operation who had not had it isolated before operation (figure). The isolation rate for *H influenzae* was consistently higher with bacitracin chocolate agar than with chocolate agar and a bacitracin disc.

Table 2 Preoperative Haemophilus influenzae colonisation in relation to postoperative chest infection

	Preoperative H influenzae	
	Present	*Not present*
Chest infection	9	15
Total	17*	91*

*p < 0·01 (χ^2 test, Yates's correction).

S pneumoniae was present in six patients before operation, but only in two on the first and third postoperative days. In contrast, the incidence of coliform colonisation increased from two before operation to 14 on the third postoperative day, falling again to four patients on the fifth day. In addition, normal oropharyngeal bacterias were isolated in all patients before and after operation.

Postoperatively 24 patients (22%) developed a chest infection, which became clinically apparent on the second, third, or fourth day. A sputum sample was obtained from 20 of these but in only eight patients was a definite pathogen isolated—*H influenzae* from six patients and *S pneumoniae* from two. Four of the patients with *H influenzae* in the sputum at the time of infection had had this organism in the oropharynx; the two patients infected with *S pneumoniae* had not had this organism isolated from the oropharynx. Coliform species were isolated from the sputum of a further nine patients, two of whom had had a coliform organism in the oropharynx. The mean length of postoperative stay was 8·3 (SD 5·4) days; it was increased in patients with chest infections to 10·1 days, compared with 7·8 days in those without infection, a non-significant difference (p = 0·071). Of the infections, 11 resolved spontaneously, 13 were treated with additional physiotherapy, and nine required additional medication, including antibiotics and bronchodilators.

Nine of 17 patients (53%) with *H influenzae* colonisation before operation developed infection compared with 15 of the 91 (16·5%) non-colonised patients (p < 0·01) (table 2). There was also a significant relation between smoking and *H influenzae* colonisation, 10 of 37 smokers (27·0%) having preoperative *H influenzae* colonisation compared with seven of 71 non-smokers (10%) (p < 0·05). In the non-smokers there was no significant relation between preoperative *H influenzae* colonisation and the development of postoperative chest infection, though the number in this group is small. There was, however, a significant association between smoking and postoperative chest infection (p < 0·01).

No significant relation could be determined between the presence of *S pneumoniae* and either infection or smoking, but the numbers are small. There was no association between the development of infection or smoking habit and the presence of coliform organisms on the third postoperative day.

Discussion

Chest infection remains a common source of postoperative morbidity after elective upper abdominal surgery. The incidence has changed little over the past 50 years and ranges from 17% to 38%,[1-4 9] depending on the criteria used to diagnose infection. The predominant risk factors are cigarette smoking and smoking related lung disease.[1-4]

Growth of *H influenzae* and of *S pneumoniae* was investigated as these organisms have been identified as the major pathogens in previous studies, accounting for 72·9% to 78·3%[10] of postoperative chest infections. We also recorded the presence of coliform organisms because of the importance of Gram negative bacilli in the aetiology of nosocomial infection.[11 12]

Previous studies of postoperative chest infection have used a combination of fever,[1 2 13] cough productive of purulent sputum,[1 2 4 13] chest signs,[1 13] and radiographic change[2 4 13] to diagnose chest infection. The production of purulent sputum indicates infection, though increased bronchial secretions in themselves may simply follow intubation and anaesthesia. Sputum purulence was therefore considered to be sufficient evidence of chest infection when only one other criteria was present. In the absence of purulent sputum four of the less specific criteria were required to make the diagnosis. With this system some patients with infection could possibly have been omitted but patients without infection are unlikely to have been included in the infection group.

The incidence of *H influenzae* colonisation in the oropharynx preoperatively was 15·7%, which is similar to the 14·6% reported in a similar population of patients. Isolation was remarkably constant before and after surgery, allowing preoperative colonisation to be used as indicating a persistent state for the purposes of analysis.

The reason for the small fall in isolation rates for *S pneumoniae* is not clear, but may represent a response to the antibiotic given. The numbers were too small for further analysis.

Coliform species were isolated in only two patients before operation. Both were unwell and a relation to severity of illness has been found previously.[13] The incidence in the postoperative period increased, perhaps as a result of the cefuroxime administered as prophylaxis or the degree of illness (or both), though the incidence of *H influenzae* colonisation was not altered significantly. In the few patients who received no antibiotics the isolation rates of *H influenzae* were also unchanged.

The yield of microbiologically proved infection was low (33%), as noted in previous studies of postoperative chest infection.[2] We were therefore unable to draw any conclusion about the relation between the preoperative presence of an oropharyngeal pathogen and the organism causing infection.

We have found a significant relation between *H influenzae* carriage and both postoperative chest infection and cigarette smoking. Smoking increases the risk of postoperative chest infection and may also increase *H influenzae* colonisation independently. This is consistent with the finding in a previous study of oropharyngeal colonisation in the perioperative period,[6] where an association was found between *H influenzae* and chronic bronchitis. Alternatively, *H influenzae* colonisation may be the primary risk factor for infection in smokers. Infection is more likely to be associated primarily with smoking, and this is supported by the low incidence of infection in patients with *H influenzae* colonisation who do not smoke. No significant association could be detected between smoking or infection and isolation of pneumococci, but numbers were small. Nor was an association found between smoking or postoperative chest infection and the isolation of coliform species. Although coliform isolation increased after operation, we found no evidence that this was of clinical importance.

We have found a significant relation between preoperative *H influenzae* colonisation and the development of postoperative chest infection in cigarette smokers. The importance of cigarette smoking as a risk factor for infection may be due at least in part to the presence of *H influenzae* in the oropharynx. Whether efforts to eradicate *H influenzae* would reduce the incidence of chest infection remains to be seen.

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