Diagnosis of nosocomial pneumonia in medical ward: repeatability of the protected specimen brush

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Diagnosis of nosocomial pneumonia in medical ward: repeatability of the protected specimen brush. B. Herer, C. Fuhrman, D. Demontrond, Z. Gazevic, B. Housset, C. Chouaïd. ©ERS Journals Ltd 2001.
ABSTRACT: The aims of this study were to assess the repeatability of two pairs of protected specimen brushes (PSB) done successively in the same lung area and either processed at the bedside or in the laboratory, and to provide a description of the bacteriological findings in 39 cases of suspected nosocomial pneumonia occurring in nonventilated patients.

Four PSB were divided into two pairs. One pair of brushes (PB) was prepared at bedside and then sent to the laboratory; the other pair (PL) was immediately sent to the laboratory for complete processing.

According to a 10^3 colony forming units (cfu)·mL^{-1} threshold, 49% out of 156 PSB were positive. Using the 10^3 cfu·mL threshold, the PL brushes were 89.7% concordant while the PB brushes were 76.9% concordant. The repeatability as expressed by K-value of the cultures of PSB was higher for PL brushes than for PB brushes (K-values of 0.795 and 0.537 respectively, p = 0.12). Bacterial species were isolated in 58.3% of 156 PSB (176 isolates). In 14 cases, cultures of PSB disclosed more than one micro-organism in a concentration $>10^3$ cfu·mL^{-1}. The most frequently isolated organisms were *Pseudomonas* spp. (23.9%), Enterobacteriaceae (23.3%), *Streptococcus* spp. (21.6%) and *Staphylococcus* spp. (13.1%). Polymicrobial cultures were more frequent if the patient had a tracheostomy (seven out of the nine patients with a tracheostomy *versus* seven out of the 30 patients without a tracheostomy, p < 0.01). Bacteriological discrepancies leading to a potential troublesome choice in antibiotherapy were observed in 31.8% of the patients for PL brushes and 56.5% of the patients for PB brushes.

There is a low degree of repeatability of protected specimen brushes outside intensive care units which seem dependent on sampling processing. The distribution of pathogens found in case of suspicion of nosocomial pneumonia in nonventilated patients appears to be similar to that obtained in ventilator-associated pneumonia.
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Nosocomial pneumonia (NP) is the second most common cause of nosocomial infections in France [1]. Mechanical ventilation is a major risk factor for NP [2], and ventilator-associated pneumonia (VAP) may increase the risk of death in critically ill patients [3, 4]. However, less data is available for NP occurring in nonventilated patients than in ventilated patients [5].

In VAP, diagnostic strategy remains controversial [6, 7]. Even if no diagnostic criteria for NP is totally accurate, protected specimen brush (PSB) or bronchoalveolar lavage (BAL) are the main diagnostic tools. PSB was first described by WIMBERLEY *et al*. [8]. The transection of the PSB has been reported to be performed either at bedside [9–11] or in the laboratory [12, 13], where all the microbiological processing will be finally done. It may be assumed that differences in this procedure may influence the microbiological results.

The aims of this study were to assess the repeatability of two pairs of PSB performed successively in the same lung area, PSB in nonventilated patients, and either processed at the bedside or in the laboratory, and to collect the bacteriological data in 39 cases of suspected NP occurring in nonventilated patients.

Methods

Patient population

The Forcilles centre is a 408-bed facility mainly (70%) constituted of intermediary care or convalescent beds.

Thirty-nine patients were prospectively and consecutively included in this monocentric study. NP was suspected on relatively wide criteria since clinical criteria alone might not reliably predict patients with and without NP [14]. The following items were required to include patients in the study [1, 3]: recent

and persistent infiltrate on the chest radiograph and 2 of the following items: temperature $\geqslant 38.5°C$ or $< 36.5°C$; leukocytosis (white blood cell (WBC) $> 15,000 \cdot mm^{-3}$) or leukopenia (WBC $< 4,000 \cdot mm^{-3}$); purulent tracheal secretions. No significant microbiological correlations were obtained in this study with blood or pleural fluid cultures, which were all negative; this fact is relevant, with previous reports stating that positive blood [15] or pleural [14] cultures are uncommon in patients with NP. No autopsy specimens were sent for cultures, since histological confirmation [12] of pneumonia is unlikely to be performed in most nonintensive care units. In all patients either the symptoms developed after 72 h of hospitalization, or the admission in the hospital followed a previous prolonged stay in another hospital. The use of antibiotics within the two previous days was recorded. Each patient gave informed consent to the study.

Study design

Fibreoptic bronchoscopy was performed with topical anesthaesia using xylocaine limited to the nose and pharynx, except for the nine patients with tracheostomy, for whom no topical anesthaesia was used.

PSB was performed as previously described by WIMBERLEY et al. [8]. Four plugged telescoping catheter brushes were successively inserted through the working channel, advanced 2–3 cm beyond the tip of the bronchoscope. The distal plug was ejected and the brush was then advanced beyond the tip of the inner cannula 3–4 cm into the bronchus, gently rotated a few times and retracted a few cm into the inner cannula. The whole unit was removed from the bronchoscope. The sampling procedure lasted ~5 min. All four PSB were obtained from the same segment or subsegment of the lung.

The PSB were processed in two pairs. For one pair (PB), the processing began outside the laboratory, at the bedside. After cleaning of the distal portion of the catheter with 70% ethanol, the two brushes (PB1 and PB2). were aseptically cut and placed in a sterile vial containing 1 mL of lactate Ringer′s solution [16] and then sent to the laboratory. For the other pair of brushes (PL), both brushes (PL1, and PL2) were put into a sterile bag and the total processing, including the initial cutting of the brushes, was carried out inside the laboratory. The order of processing PB and PL was randomly assigned. All specimens were transported to the laboratory within 30 min. Microbiological procedures were performed for all four brushes according to the protocol described by WIMBERLEY et al. [8]. All vials containing the PSB and medium transport were vortexed. Three 10-fold dilutions were prepared, and 0.1-mL aliquots of each sample were streaked on four agar plates. Cultures were incubated at 37°C under aerobic conditions and in a carbon dioxide (CO_2) atmosphere. If the culture was positive, counts of colony forming units (cfu) per millilitre, identification of each species, and test of susceptibility to antibiotics were performed. To separate isolates

considered to be in high concentration (i.e. confirmed lung infection) from isolates in low concentration (i.e. airway colonization), the previously described cut-off point of 10^3 $cfu \cdot mL^{-1}$ was used [8, 12].

Statistical methods

Quantitative data are expressed as mean $\pm$ SD. Chi-squared statistics were used for categorical variables. Repeatability of each PSB processing (PB and PL) was assessed using K test. Absence of systematic bias was determined using the MacNemar test. K-values were given with positive and negative (Ppos and Pneg) agreements [17–20].

Results

Thirty-nine episodes of suspected NP occurring in 39 patients were analysed. Patient characteristics are reported in table 1. Reasons for hospitalization were: neoplastic disease (oesophagus, larynx and bronchi, n=17); respiratory insufficiency (n=9); management of postoperative complications of abdominal surgery (n=8); neurological disease (n=4); cardiac insufficiency (n=1). All patients had at least one risk factor for NP [21]: central nervous system dysfunction, chronic obstructive pulmonary disease (COPD), recent thoracic or abdominal surgery, history of aspiration, age >65. Nine patients had a tracheostomy (patients Nos. 9, 16, 22, 24, 26, 29, 31, 37 and 38, table 2), and three were ventilated with nocturnal intermittent positive pressure ventilation (IPPV). Nine patients received antibiotics within two days before PSB procedure. Six (14.6%) episodes were eventually lethal. All six deaths were attributed to NP. Death occurred in 2/3 ventilated patients versus 4/36 of the nonventilated patients (p<0.01). No deaths occurred during bronchoscopy. Transient decreased oxygen saturation below 95% was corrected by additional oxygen. There was no episode of bronchial haemorrhage during bronchoscopy. Using the 10^3 $cfu \cdot mL^{-1}$ threshold, PSB culture was positive in 19, 18, 21 and 19 out of 39 patients, for PB1, PB2, PL1 and PL2 respectively (49% out

Table 1. – Patients characteristics

Patients characteristics	
Sex M:F	25:14
Age yrs*	63.5 ± 12.7
Underlying risk factor for NP	
Recent surgery	23 (59)
History of aspiration	18 (46)
COPD	17 (44)
Age >65 yrs	15 (38)
CNS dysfunction	9 (23)
Tracheostomy	9 (23)
Nocturnal IPPV	3 (8)

Data presented as n (%) unless otherwise stated. M: male; F: female; NP: nosocomial pneumonia; COPD: Chronic obstructive pulmonary disease; CNS: central nervous system; IPPV: intermittent positive pressure ventilation. *: data presented as mean $\pm$ SD.

Table 2. – Clinical outcome, prior antibiotic treatment and culture results of four protected specimen brushes (PSB) according to a 10^3 cfu·mL^{-1} threshold in 39 patients

Patient No.	Clinical outcome	Prior antibiotic treatment	Bacterial species	PL		PB	
				1st	2nd	1st	2nd
1	Deceased	N	*P. aeruginosa*	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$
2	Survived	N	nil				
3	Survived	N	nil				
4	Deceased	N	*E. coli*	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$
			S. epidermidis		$\geqslant 10^3$		
			Streptococcus spp.		$\geqslant 10^3$	$\geqslant 10^3$	
5	Survived	Y	*S. aureus*	$< 10^3$	$< 10^3$	$\geqslant 10^3$	$\geqslant 10^3$
6	Survived	N	nil				
7	Survived	N	nil				
8	Survived	Y	*Streptococcus* spp.				$\geqslant 10^3$
9	Survived	N	*A. baumanii*	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$
			S. epidermidis	$< 10^3$			
10	Survived	N	nil				
11	Survived	N	*H. influenzae*	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$
12	Survived	N	nil				
13	Survived	Y	nil				
14	Survived	N	*S. aureus*	$< 10^3$		$< 10^3$	
			Streptococcus spp.			$\geqslant 10^3$	
15	Survived	N	*S. aureus*	$\geqslant 10^3$	$\geqslant 10^3$	$< 10^3$	$\geqslant 10^3$
			P. aeruginosa	$\geqslant 10^3$	$\geqslant 10^3$		$\geqslant 10^3$
			Providencia spp.	$\geqslant 10^3$	$\geqslant 10^3$		$\geqslant 10^3$
16	Survived	N	*S. pneumoniae*		$\geqslant 10^3$		$< 10^3$
			Moraxella spp.		$\geqslant 10^3$		
17	Survived	Y	*Streptococcus* spp.	$\geqslant 10^3$			
18	Deceased	N	*Streptococcus* spp.	$\geqslant 10^3$	$\geqslant 10^3$		$\geqslant 10^3$
			Moraxella spp.	$\geqslant 10^3$	$\geqslant 10^3$		$\geqslant 10^3$
			Neisseria spp.	$< 10^3$	$< 10^3$		$< 10^3$
			H. parainfluenzae	$\geqslant 10^3$	$\geqslant 10^3$		
19	Survived	Y	*E. coli*	$< 10^3$	$< 10^3$	$< 10^3$	
20	Survived	N	*S. pneumoniae*	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$
21	Survived	N	*P. aeruginosa*	$\geqslant 10^3$	$\geqslant 10^3$		$\geqslant 10^3$
22	Deceased	N	*K. pneumoniae*	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$
			P. aeruginosa	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$
			Streptococcus spp.	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$
23	Survived	N	*S. aureus*	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$
			Citrobacter spp.	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$
24	Survived	N	*P. aeruginosa*	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	$< 10^3$
			Streptococcus spp.	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$
			Neisseria spp.	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	$< 10^3$
25	Survived	N	*Streptococcus* spp.	$\geqslant 10^3$		$\geqslant 10^3$	
26	Survived	N	*P. aeruginosa*	$\geqslant 10^3$			
			A. xylooxydans	$\geqslant 10^3$			
27	Survived	Y	*P. aeruginosa*	$< 10^3$		$< 10^3$	$< 10^3$
28	Survived	N	*S. aureus*	$< 10^3$			
29	Survived	N	*P. aeruginosa*	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$
			S. aureus	$\geqslant 10^3$		$< 10^3$	$< 10^3$
			Neisseria spp.	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	$< 10^3$
			Streptococcus spp.	$\geqslant 10^3$			
30	Survived	N	*Streptococcus* spp.			$\geqslant 10^3$	$\geqslant 10^3$
31	Survived	Y	*Proteus* spp.	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$
			P. aeruginosa	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$
			E. coli	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$
			S. marcescens	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$
			Streptococcus spp.	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$
32	Survived	N	nil				
33	Survived	N	nil				
34	Survived	Y	*E. coli*	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$
			Streptococcus spp.	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$
35	Survived	N	*Corynebacteria* spp.		$\geqslant 10^3$	$\geqslant 10^3$	
			S. marcescens	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	
			P. aeruginosa	$\geqslant 10^3$	$< 10^3$	$< 10^3$	$< 10^3$
36	Deceased	Y	*P. aeruginosa*	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$

Table 2. Continued

Patient No.	Clinical outcome	Prior antibiotic treatment	Bacterial species	PL		PB	
				1st	2nd	1st	2nd
37	Deceased	N	*P. aeruginosa*	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$
			Proteus spp.	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$
			A. xylooxydans	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	
			S. aureus	$\geqslant 10^3$	$\geqslant 10^3$	$\geqslant 10^3$	
38	Survived	Y	*Streptococcus* spp.	$\geqslant 10^3$	$\geqslant 10^3$	$< 10^3$	
39	Survived	Y	nil				

PL: PSB processed in the laboratory; PB: PSB processed outside the laboratory; N: no; Y: yes; *P. aeruginosa*: *Pseudomonas aeruginosa*; *E. coli*: *Escherichia coli*; *S. epidermidis*: *Staphylococcus epidermidis*; *S. aureus*; *Staphylococcus aureus*; *A. baumanii*: *Acinetobacter baumanii*; *H. influenzae*: *Haemophilus influenzae*; *S. pneumoniae*; *Streptococcus pneumoniae*; *H. parainfluenzae*: *Haemophilus parainfluenzae*; *K. pneumoniae*: *Klebsiella pneumoniae*; *A. Xylooxydans*: *Alcaligenes xylooxydans*; *S. marcescens*: *Staphylococcus marcescens*.

of a total 156 PSB). There was no influence of antibiotics administration on the positivity or negativity of PSB. The clinical outcomes, the existence of a prior antibiotic treatment and the culture results of the four PSB in the 39 patients are presented in table 2. Patients whose PSB specimens did not reach the 10^3 cfu·mL^{-1} threshold were not given antibiotics thereafter.

The repeatability of each PSB processing (PB and PL) is given in tables 3 and 4. When considering qualitative results (*i.e.* presence or absence of bacterial colonies without using the 10^3 cfu·mL^{-1} threshold), the concordance of PL results was 82.0% (K = 0.632) *versus* 79.5% (K = 0.583) for PB. MacNemar tests were nonsignificant for both pairs, assessing absence of systematic difference between first and second PSB. However, K-values did not statistically differ between PB and PL (p = 0.80). When considering quantitative

results (*i.e.* using the 10^3 threshold), the concordance for PL results (89.7%, K = 0.795) was higher than for PB results (76.9%, K = 0.537) but without statistical significance (p = 0.12). Thus, a diagnosis of NP was troublesome because of conflicting data in PSB results in 10.3% (PL), 23.1% (PB) and 30.8% (aggregation of PB and PL results) of the cases. Results were similar in patients without tracheostomy (n = 30), with PL and PB K-values of 0.862 and 0.528, respectively (p = 0.055). The order of sampling the pairs of PSB did not influence culture results.

Micro-organisms were found in 91 of the 156 PSB (58.3%), and 176 bacterial species were isolated (table 5). In 14 patients at least one PSB culture disclosed more than one micro-organism in concentrations $\geqslant 10^3$ cfu·mL^{-1}. Polymicrobial cultures were more frequent in patients with tracheostomy (seven out of nine patients with tracheostomy *versus* seven

Table 3. – Repeatability of the two protected specimen brushes (PSB) processed in the laboratory (PL) and outside the laboratory (PB) in 39 episodes of suspected nosocomial pneumonia: qualitative results

Qualitative results		First PSB			
		PL		PB	
		Recovery of bacteria	Sterile culture	Recovery of bacteria	Sterile culture
Second PSB	Recovery of bacteria	20	1	18	4
	Sterile culture	6	12	4	13
K cofficient ± SD		0.632 ± 0.126		0.583 ± 0.131	
Ppos/Pneg		0.851/0.774		0.818/0.746	

Ppos: positive agreement; Pneg: negative agreement. p = 0.8.

Table 4. – Repeatability of the two protected specimen brushes (PSB) processed in the laboratory (PL) and outside the laboratory (PB) in nosocomial pneumonia: quantitative results

Quantitative results		First PSB			
		PL		PB	
		$\geqslant 10^3$ cfu·mL^{-1}	$< 10^3$ cfu·mL^{-1}	$\geqslant 10^3$ cfu·mL^{-1}	$< 10^3$ cfu·mL^{-1}
Second PSB	$\geqslant 10^3$ cfu·mL^{-1}	18	1	14	4
	$< 10^3$ cfu·mL^{-1}	3	17	5	16
K coefficient ± SD		0.795 ± 0.097		0.537 ± 0.135	
Ppos/Pneg		0.900/0.895		0.757/0.780	

Ppos: positive agreement; Pneg: negative agreement. p = 0.12.

Table 5. – Micro-organisms isolated from 156 protected specimen brushes performed in 39 episodes of suspected nosocomial pneumonia

Micro-organisms	Total specimens	Monomicrobial		Polymicrobial	
		$< 10^3$ cfu·mL^{-1}	$\geqslant 10^3$ cfu·mL^{-1}	$< 10^3$ cfu·mL^{-1}	$\geqslant 10^3$ cfu·mL^{-1}
Total	176	10 (5.7)	26 (14.8)	18 (10.2)	122 (69.3)
Gramnegative bacteria	113 (64.2)	7	14	10	82
Pseudomonas spp.	42	4	10	4	24
Escherichia coli	15	3	0	0	12
Other Enterobacteriacae	15	0	0	0	15
Moraxella and *Neisseria* spp.	15	0	0	5	10
Proteus and *Providencia* spp.	11	0	0	1	10
Acinetobacter and *Alcaligenes* spp.	9	0	0	0	9
Haemophilus spp.	6	0	4	0	2
Grampositive bacteria	63 (35.8)	3	12	8	40
Streptococcus spp.	38	0	10	2	26
Staphylococcus spp.	23	3	2	6	12
Corynebacteria spp.	2	0	0	0	2

out of 30 without tracheostomy, odds ratio (OR)= 11.5 (2.1–60.9), p<0.01). Nine PSB (three patients) were positive for fungal species *(Candida albicans* and *Candida glabrata))*. All fungi were found in polymicrobial cultures and none were considered pathogenic. The most frequently isolated organisms were *Pseudomonas* spp. (23.9%), Enterobacteriaceae (23.3%), *Streptococcus* spp. (21.6%) and *Staphylococcus* spp. (13.1%). When considering only bacteria recovered at a threshold $\geqslant 10^3$ cfu·mL^{-1}, a similar distribution was found: Enterobacteriaceae (25.0%), *Streptococcus* spp. (24.3%), *P. aeruginosa* (23.0%) and *Staphylococcus* spp. (9.5%).

The clinical implications in directing the choice of antibiotherapy based on the bacteria recovered at a threshold $\geqslant 10^3$ cfu·mL^{-1} in at least one of the two PSB were assessed. The diagnosis of NP was hence considered in 22/39 PL results and 23/39 PB results. Bacteriological discrepancies leading to a troublesome choice in antibiotherapy included species recovered in concentration $\geqslant 10^3$ cfu·mL^{-1} in one PSB while absent in the other (17.9% of the patients with PL results and 23.1% of the patients with PB results, p=NS between

PL and PB), and results spread out on each side of the 10^3 cfu·mL^{-1} cut-off (2.6% of the patients with PL results and 15.4% of the patients with PB results, p-value was not significant between PL and PB). Table 6 summarizes the bacteriological discrepancies in patients in whom a diagnosis of NP was considered.

Discussion

In contrast with VAP for which the literature is abundant [22], the management of NP in nonintubated patients remains poorly documented [5]. The diagnosis of NP in nonintubated patients is difficult because, as in VAP, it may be assumed that its clinical (*i.e.* noninvasive) diagnosis is imprecise and less accurate than with invasive methods [14]. In addition, the validation of a reliable technique of microbiological diagnosis of NP, with a gold standard of diagnosis, such as histological confirmation of pneumonia [12], is unlikely to be done in most of the nonintensive care units of medical and surgical wards. However, in selected centres, NP diagnosis strategy in

Table 6. – Bacteriological discrepancies in patients in whom a diagnosis of nosocomial pneumonia was considered (at least one species isolated from at least one protected specimen brush (PSB) in concentration $\geqslant 10^3$ cfu·mL^{-1})

	Species recovered in concentration $\geqslant 10^3$ cfu·mL^{-1} in one PSB while absent in the other		Samples spread out on each side of the 10^3 cfu·mL^{-1} cut-off	
	PL	PB	PL	PB
Patients	7	9	1	6
Species	11	12	1	6
Gramnegative bacteria	3	5	1	5
Pseudomonas spp.	1	2	1	2
Enterobacteriacae	0	2	0	1
Moraxella and *Neisseria* spp.	1	1	0	2
Alcaligenes spp.	1	0	0	0
Grampositive bacteria	8	7	0	1
Streptococcus spp.	5	5	0	0
Staphylococcus spp.	2	1	0	1
Corynebacteria spp.	1	1	0	0

PL: PSB processed in the laboratory; PB: PSB processed outside the laboratory.

nonventilated patients is built on fibreoptic broncho-scopy with lower respiratory secretion specimens obtained either by PSB or BAL.

The present study was designed to assess the repeatability of PSB in nonventilated patients. This issue has been largely addressed in VAP, but to the authors' knowledge, has not been studied in non-ventilated patients. As in VAP, the repeatability of the PSB may also be questioned in nonventilated patients. It was found that the results of PSB are dependent on sampling processing, as shown by higher repeat-ability when the PSB are transected inside rather than outside the laboratory. The difference was not statistically significant, but due to the low number of patients included, statistical testing power was low. These preliminary data may justify additional studies on a larger scale.

To the authors' knowledge, three studies addressed the repeatability of PSB or BAL in VAP. MARQUETTE et al. [13] found a 13.6% discordance in quantitative bacterial results, but there was a noticeable intra-subject variability (16%). TIMSIT et al. [11] found similar results with a 24% discordance with regard to the recommended diagnostic threshold of 10^3 cfu·mL^{-1}. The repeatability of BAL, with pulmonary infection confirmed above a 10^4 cfu·mL^{-1} threshold was studied by GERBEAUX et al. [23]. The K-value was 0.74 in this instance, with a 9% discordance of BAL samplings. The presented results (a discordance rate of 10.3% for laboratory processing of PSB and 23.1% for bedside processing of PSB) are similar to the dis-cordance rates found by MARQUETTE et al. [13] (13.6% with laboratory transection) and TIMSIT et al. [11] (24% with bedside transection). In addition, because of conflicting data in the bacteriological results, the antibiotic choice when the diagnosis of NP was considered would have been troublesome in 31.8% (7/22) of the patients after laboratory processing of PSB and 56.5% (13/23) of the patients after bedside processing of PSB. This finding confirms that in nonintensive care unit patients, as reported in VAP [11, 24], it is difficult to choose an adequate treatment of NP because of the low degree of repeatability of this technique.

The patients were all studied in a secondary care facility, and most of them had previously stayed in another hospital, so every potential pulmonary infec-tious manifestation was attributable to NP rather than community-acquired pneumonia. In addition, all patients had at least one risk factor predisposing to NP [21]. The distribution of the recovered pathogens show that the most frequently isolated organisms were *Pseudomonas* spp. (23.9%), Enterobacteriaceae (23.3%), *Streptococcus* spp. (21.6%) and *Staphylo-coccus* spp. (13.1%). The distribution of the micro-organisms of the present study is similar to that reported by TROUILLET et al. [25] in a study performed in a Parisian intensive care unit, including the isolation of fungal agents.

In conclusion, as for ventilator-associated pneumo-nia, there is a low degree of repeatability of protected specimen brush outside intensive care units. Since the results of protected specimen brush seem to be dependent on sampling procedures, it is suggested that protected specimen brush should be processed in nonintubated patients with as little manipulation as possible and, when possible, all processing should be exclusively performed inside the laboratory. Further studies are needed to improve the diagnostic pro-cedure of nosocomial pneumonia in nonintensive care unit patients, since the distribution of pathogens found in cases of suspected of nosocomial pneumonia in nonventilated patients appears to be similar to that obtained in ventilator-associated pneumonia.

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