Hygiene of nasal masks used at home for non-invasive ventilation in children

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Madam,

Non-invasive ventilation (NIV) is used increasingly in children with chronic respiratory insufficiency.[1,2] For best results NIV requires a nasal or face mask adapted to the paediatric patient. Other devices used with masks, such as nebulisers in cystic fibrosis (CF) patients or spacer devices in asthmatics, can be microbiologically contaminated.[3–6] As we found no literature data about contamination of NIV nasal masks, we conducted a pilot study to evaluate the methods of cleaning used by patients at home and their rate of microbial contamination.

Children treated daily with NIV and nasal mask during at least the three previous months were solicited for participating in a study divided into two parts. They first completed a questionnaire concerning the NIV characteristics (indication, date of beginning, frequency of use per day, presence of humidifier), and the maintenance of masks at home (cleaning phases, frequency, disinfectants used, renewal frequency). Second, the interior part of their masks (and, when existing, of the cushion) was rinsed in a standardised way with 10 mL of sterile 0.9% saline solution. The washing solution was recovered using a sterile syringe, and collected in a sterile collector tube. A cotton swab was used to clean the interior parts of the mask in contact with the patient. When possible, a microbiological analysis of the sputum was performed. All samples were sent to the laboratory and inoculated on to five agar plates including chocolate Poly ViteX agar, Columbia colistin–nalidixic acid (CNA) agar, MacConkey agar, Cepacia agar, and blood agar. All growth media were purchased from bioMérieux (Marcy l'Etoile, France) and were incubated at 37 °C for 48 h except for Cepacia agar that was purchased from AES laboratory (Combourg, France) and incubated at 30 °C for 5 days. Colonies growing on the various media were identified using standard microbiological methods including Gram-staining, catalase and oxidase activity, API system (bioMérieux), and VITEK 2 Auto system (bioMérieux) and standard procedure for antibiotic susceptibility testing.

Among the 52 patients with NIV followed up, 12 children were included (6 boys, mean age 13.3 years; range: 7–19). They were treated for CF ($N = 6$), spinal amyotrophy ($N = 3$), Duchenne muscular dystrophy ($N = 2$) or achondroplasia ($N = 1$). All CF patients were chronically infected with various organisms; other patients were usually free from infection. NIV was started at a mean of 34.7 months (range: 3–131), and used 9.8 h per day (range: 6–14). Four NIV apparatus had a humidifier. Nasal masks were replaced two to 12 times per year. The frequency of mask-cleaning was variable (mean: 2.9 times per week; range: 0–7). One mask was never cleaned. The others were washed with water and soap (100%), rinsed with tap water (100%), and dried in ambient air (64%) and/or with absorbent tissue (45%). Only one mask was disinfected with wipes impregnated with detergent product. Two cultures were positive (16.7%) (Table I). One mask, belonging to a 17-year-old CF female chronically infected with *Staphylococcus aureus* and waiting for lung transplantation, was contaminated with *S. aureus* with identical antibiotic susceptibilities to that found in her sputum. The second mask, belonging to an infection free 7-year-old female with spinal amyotrophy, was contaminated with *Pseudomonas oryzihabitans*. A statistical link between the use of a humidifier and the mask contamination was noted (50% with a humidifier vs 0% with no humidifier; $P = 0.03$).

In our study the masks are not cleaned after each use, and benefit at best from only three of the four recommended steps of cleaning (washing, rinsing, drying after each use; disinfection once a day).[7] Microbial contamination is less than that described with nebulisers or spacer devices, but reaches up to 16.7%.[3–6] It is interesting to note that, in CF, the *a priori* same organism may be found in sputum and NIV nasal mask, suggesting that there should be a systematic change of the whole NIV apparatus when the patient is awaiting lung transplantation to avoid reinfection. To know whether *P. oryzihabitans* has a pathogenic effect in our patient is difficult because it has only been incriminated in immunocompromised patients, except one immunocompetent patient with bronchiectasis.[8] Other studies are needed to confirm the link we found between the microbial contamination of NIV nasal masks and the use of a humidifier, but these findings are in accordance with studies on nebulisers, where humidity favours contamination.[3]

In conclusion, nasal masks of NIV are insufficiently disinfected at home. They can be contaminated by different bacteria and may be a source for airway colonisation and/or infection.

Table I
Microbial data from nasal masks and sputum of 12 children treated with long-term non-invasive ventilation (NIV)

Disease	NIV with a humidifier	Antibiotics at the time of the study	Liquid rinsing	Cotton swab	Sputum
Cystic fibrosis	Yes	Yes	Sterile	Sterile	*S. aureus*
Cystic fibrosis	No	Yes	Sterile	Sterile	*S. aureus*
Cystic fibrosis	No	No	Polymicrobial flora	Sterile	Polymicrobial flora
Cystic fibrosis	No	No	Sterile	Sterile	*P. aeruginosa*
Cystic fibrosis	Yes	Yes	Polymicrobial flora	*S. aureus*	*S. aureus* *P. aeruginosa* *Candida albicans*
Cystic fibrosis	No	Yes	Sterile	Sterile	Sterile
Spinal amyotrophy	Yes	Yes	Polymicrobial flora	*P. oryzihabitans*	Polymicrobial flora
Spinal amyotrophy	Yes	Yes	Sterile	Polymicrobial flora	Polymicrobial flora
Spinal amyotrophy	No	Yes	Sterile	Sterile	Not obtained
Duchenne disease	No	Yes	Polymicrobial flora	Polymicrobial flora	Not obtained
Duchenne disease	No	No	Polymicrobial flora	Polymicrobial flora	Not obtained
Achondroplasia	No	No	Sterile	Sterile	Not obtained

Conflict of interest statement
None declared.

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