# SPACER - A POTENTIAL HARBOUR OF PATHOGENIC BACTERIA

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**ABSTRACT**

**BACKGROUND**

Valved holding chambers (VHCs) or spacers are devices which have been used with pressurised metered dose inhaler containing inhaled corticosteroids and beta agonists or muscarinic inhibitors in patients of chronic obstructive airway diseases. Spacers can be a reservoir of bacteria.[1] Biofilms may be produced by bacteria which protect them from antibiotic penetration thus making them antibiotic resistant. There are very few studies on spacer devices related to bacterial infection in patients due to spacer use.

**OBJECTIVES**

To investigate if spacer is a potential source of infection in patients of obstructive airway diseases. To identify the organisms grown and whether they produce biofilms.

**METHOD**

We enrolled 40 patients of diagnosed obstructive airway disease to whom we had prescribed metered dose inhaler with spacer for the first time. We took swabs from the inner wall of the spacer. Three samples were collected with each taken one week apart, 1st being the pre-use sample and 2nd and 3rd being post use. 3rd sample especially being taken after washing the spacer under tap water, drying it in room air by the patient at home and then collecting the sample with aseptic precautions.

**RESULTS**

Our data identified growth of micrococci, bacillus, and Pseudomonas in 8 post use spacer swab samples and 5 pre-use samples also grew pathological and non-pathological bacteria.

**CONCLUSION**

Since there was a growth of bacteria in some spacers, this could be a source of infection in these patients.

**KEYWORDS**

Spacers, Valved Holding Chambers, Biofilm, COPD.

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**INTRODUCTION:** Exacerbation of COPD[1] can be caused by infection by bacteria or viruses (which may coexist), environmental pollutants or unknown factors.

The exacerbation of chronic obstructive pulmonary disease (COPD) is defined by GOLD 2015 as "an acute event characterised by a worsening of the patient's respiratory symptoms that is beyond normal day-to-day variation and leads to a change in medication." Hospitalisation for a COPD exacerbation is associated with a poor prognosis with increased risk of death.

The goal of treatment in COPD exacerbation is to minimise the impact of the current exacerbation and to prevent the development of subsequent exacerbations.

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Bronchoscopy studies have shown that at least 50% of patients also have bacteria colonising their lower airways in the stable phase of the disease. On the other hand, there is some indication that the bacterial burden increases during some exacerbations of COPD.

Very few studies have evaluated colonisation of spacers by bacteria while being daily used by patients of COPD. Spacers can be a reservoir of bacteria.[2] A pilot study was done by our department in which we have found many pathological bacteria grown from swabs taken up from spacers used by patients. However, it was done with single sample of swab taken from the spacer and biofilm formation were not studied.

In light of this, we speculate that perhaps the spacers are colonised by pathological bacteria and biofilm is being formed inside the spacer's inner-wall.

**METHODS:** After Ethics Committee clearance, this longitudinal study evaluated 40 patients of clinically

diagnosed COPD to whom we had prescribed metered dose inhaler with spacer for the first time. Patients are randomly selected from Outpatient Department of Pulmonary Medicine. The study was conducted between June 2014 to Dec 2014. Inclusion criteria were stable patients of COPD, newly prescribed spacer with ICS or LAMA/LABA. We excluded the following patients: (1) Having recent history of acute exacerbation within last 3 months, (2) age below 12 years, (3) lost to followup for three consecutive visits in our OPD, (4) change of devices to be used due to any reason.

**Subjects:** Patients were also excluded if they had a previous history of other lung diseases, even after inclusion, if they change the spacer during our study or have broken it or washed it with any material and those who did not return to the hospital in one month after enrolment in study.

During the study, all patients received optimal pharmacological treatment according to the recommendation of GOLD 2015.

**Study Design:** After inclusion in the study, we took swab culture from the inner wall of the spacer with all aseptic precautions.

Three samples were collected with each taken one week apart. 1st being the pre-use sample. The spacer was being first time used by patient; however, it was not sterile. We did not use any disinfectant or even water to clean it. Patients were taught how to use the MDI with spacers as per the GOLD and GINA guidelines[3]. Patients have been instructed not to wash or use any method or material to clean the spacer at home prior to second visit. 2nd swab was taken from the spacer after one week of use. 3rd sample was taken after washing the spacer under tap water by the patient at his/her home, drying it in room air by the patient and then bring it with other medications prescribed. We collected the 3rd sample with aseptic precautions at OPD same as the earlier samples. All the samples were subjected to culture and sensitivity according to the growth. We have specifically asked for formation of biofilms in Congo red agar as required.

**Ethics:** All procedures were followed in accordance with the ethical standards of the responsible committee on human experimentation (institutional or regional) and with the Helsinki Declaration of 1975 as revised in 1983.

**RESULTS:** 40 patients were enrolled in our study and three swab samples sent from each patient's spacer. Of the 40 pre-use samples, we have 5 culture-positive swabs in which we found 3 micrococci and two bacilli were grown. From the 2nd samples of 40 patients, we found 6 culture-positive samples in which one was Pseudomonas and rest were Bacillus. From third 40 batch samples, we found 8 culture-positive swabs and in which we have 2 Pseudomonas, 1 Klebsiella, one E. coli, Two Enterococcus and rest were Bacillus. Comparing to the first sample of bacterial growth we did not have the same bacterial growth in the consecutive samples. From the two Pseudomonas cultures, we did not get any significant biofilm formation in our samples.

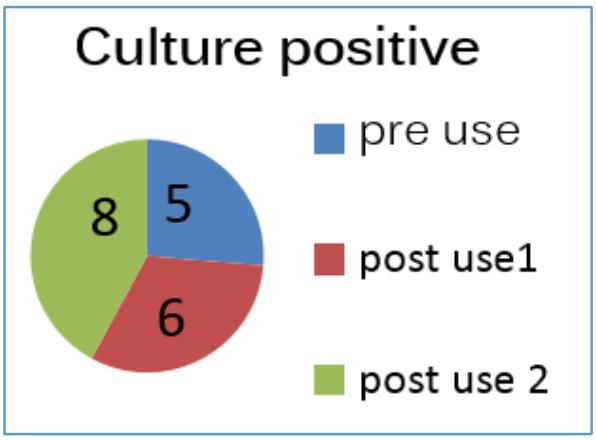


***Fig. 1: Pie chart showing No. of Culture-positive Samples Original.***

**RESULTS:** Blue: 5 pre-used samples. Red: 6 post use after 1 week. Green: Post use after 2nd week.

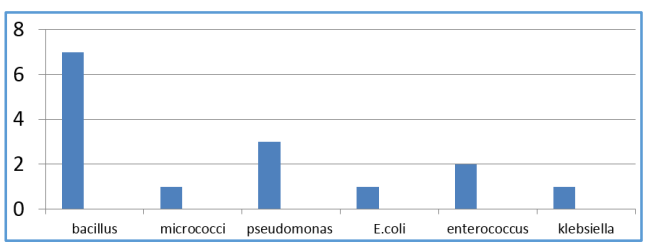


***Fig. 2: Organisms grown from Different Samples; X axis: Number of Culture-positive Samples, y axis: Different Organisms***

**DISCUSSION:** In our study, the swab cultures showed growth of bacteria such as E. coli 1/40, Micrococci 1/40, Bacillus 7/40, Enterococci 2/40 and Pseudomonas 3/40 species including both pre or post use samples. However, all our samples failed to yield growth of biofilms on culture.

A biofilm[4] is an assemblage of microbial cells which are enclosed in a matrix comprising primarily of polysaccharide material that is irreversibly associated (not removed by gentle rinsing) with a surface. The biofilm layer forms protective coat against antibiotic penetration, and since the bacteria within it grew more slowly than usual, antibiotics depending on rapid cell turnover for their bactericidal action have a relatively poor effect on them. Biofilms may form on living and non-living objects. They can grow on a wide variety of surfaces including indwelling medical devices, industrial or portable water system piping. Microorganisms attach more rapidly to hydrophobic, nonpolar surfaces such as Teflon and other plastics than to hydrophilic materials such as glass or metals.

Our results suggest there could be a potential relationship with the spacer handling methods and colonisation of bacteria in such devices. They can be a source of infection in patients of COPD. Such patients are vulnerable to bacterial infections from any source like the devices which they use daily.

Hence, all patients of obstructive airway disease should be advised to wash the spacer before first time use and thereafter once a month and especially after each respiratory infection.[5]

Washing should be done with warm water with or without dish washing detergent, and be allowed to air dry. No cloth or paper towel should be used to dry the inside of the spacer.

Spacers should not be shared with any other patient.

**Microorganisms commonly associated with biofilms on indwelling medical devices:**

- Candida albicans: Artificial voice prosthesis, Central venous catheter, Intrauterine device, Urinary catheter.
- Coagulase-negative staphylococci: Artificial hip prosthesis, Artificial voice prosthesis, Central venous catheter, Intrauterine device, Prosthetic heart valve, Urinary catheter.
- Enterococcus spp.: Artificial hip prosthesis, Central venous catheter, Intrauterine device, Prosthetic heart valve, Urinary catheter.
- Klebsiella pneumonia: Central venous catheter, Urinary catheter.
- Pseudomonas aeruginosa: Artificial hip prosthesis, Central venous catheter, Urinary catheter.
- Staphylococcus aureus: Artificial hip prosthesis, Central venous catheter, Intrauterine device, Prosthetic heart valve.

Thus, in our study, 8 (20%) of spacers had bacterial growth including Pseudomonas, micrococci, bacillus, Klebsiella E. coli which could be the potential source of infection for these COPD patients who use spacers regularly.

There was no biofilm formation in any of the samples. Further studies may be needed to identify whether spacer shape size and other spacer details may affect growth of pathogenic bacteria in them and also require comparison with sputum cultures of patients over a longer period of time.

In our study, via basic culture methods, other than growth of non-pathogenic organisms, there is a productive outcome in terms of growth of pathogenic bacteria as well. Cultures yielding organisms such as E. coli and Pseudomonas with a significant colony count motivate us to expand this kind of study to include in it more dimensions such as correlation with patient's sputum culture, finer details of spacer in terms of shape, size, single piece or detachable ones, etc. and projection of the study into a larger sample size with observing the results over a longer time period.

**REFERENCES**

1. GOLD 2015. http://www.goldcopd.it/materiale/2015/GOLD_workshop_report_2015.pdf
2. Study of placebo inhaler device by Ciara Griffin & Judith Strawbridge. 1999. www.Inmo.Ie/article/printarticle/2878
3. GINA 2015. http://ginasthma.org/
4. Microbiology principles and health science applications by loism. Bergquist and barbarapogosian. 1978:p. 224.
5. www.nationalasthma.org.au/publication/spacer-use-end-care council.