Indian Journal of Medical Microbiology, (2014) 32(3): 301-303

Brief Communication

Effect of protein coating of flocked swabs on the collection and release of clinically important bacteria

KH Harry, *KT Madhusudhan

Abstract

Clinical swab heads are often coated with biopolymers to improve the recovery and survival of organisms. To assess the effect of swab head material coating, water absorption capacity and capture and release characteristics of four pathogenic bacteria from protein coated and uncoated flocked swabs were determined. Demonstration of no uniformly higher recovery of all test bacteria from coated swabs over their corresponding uncoated swabs suggest importance of physicochemical properties of swab tip material compared with biopolymer coating, for swab selection for clinical applications.

Key words: *Flocked swabs, pathogenic bacteria, protein coating, water absorption*

Introduction

Sensitivity for detection of antigens, nucleic acids and microbes depends on the devices used for specimen collection. Although aspirates, body fluids, and tissue samples are more efficient for primary culture, a swab is frequently used as a collection device in patient care.[1] Non-spun fibre swabs such as foam and flocked swabs have demonstrated superior release characteristics due to their cellular structure of foam or open fibre structure of flocked swabs[2,3] resulting in minimum entrapment of organisms. Flocked swabs are commonly used for clinical and environmental sampling owing to their flexibility, ease of use and efficient release of microbes, antigens and nucleic acids.[2-4] Although no systematic studies were done on the effect of swab head coatings with current generation of swabs, swab heads are often coated with biopolymers such as alginate or proteins to improve the collection and stabilisation of sensitive organisms.[5-8] The present study addresses the effect of biopolymer coating of swab tip on the collection and release of pathogenic bacteria and the results will help the clinician to select a swab for diagnostic applications.

*Corresponding author (email: <ktmadhusudhan2000@yahoo.com>)
Department of Microbiology, Wake Forest University Health Sciences (KHH),Winston-Salem (KTM), Stafford Estates Drive, Salisbury, North Carolina, USA

Received: 17-07-2013
Accepted: 29-11-2013

Access this article online	
Quick Response Code:	Website: www.ijmm.org
	DOI: 10.4103/0255-0857.136574

Materials and Methods

Prototypes of protein (bovine serum albumin) coated and uncoated HydraFlock® and PurFlock® Ultra minitip swabs were obtained from Puritan Medical Products Company LLC (Guilford, ME). Commercially available minitip Nylon Flocked and ESwab of Copan Italia S.p.A. were from Hardy Diagnostics (Santa Maria, CA). The ESwab used in the study has protein (bovine serum albumin) coating. All swabs tested in the study were of similar shape and swab head size. Test organisms, namely *Streptococcus pneumoniae* ATCC 6305, *Hemophilus influenzae* ATCC 10211, *Neisseria gonorrhoeae* ATCC 43069 and *Peptostreptococcus anaerobius* ATCC 27337 were obtained from ATCC (Manasas, VA). Water absorption of whole swabs (five of each type), separated swab fibres (five samples for each type) and the culture studies to evaluate the collection and release of bacteria were done as described previously.[9] Twelve swabs of each swab type were used for culture studies. Each organism was cultured in triplicate. Statistical significance of the difference between means was compared by Tukey-Kramer Honestly Significant Difference test and the *P* values were computed[10] by analysis of variance (ANOVA) with JMP-7 (SAS Institute, Cary, NC).

Results

The water absorption of whole swabs (coated or uncoated) ranged from 13.2% to 21.6% [Table 1] with PurFlock® Ultra and ESwabs exhibiting the highest and the lowest capacities, respectively. Flocked swab head fibres are a small fraction of the total swab weight. Swab head fibres of HydraFlock® and Nylon swabs demonstrated significantly higher water absorption than PurFlock® Ultra swab head fibres [Table 1]. Water absorption of a swab enhances

Table 1: Recovery of test organisms and water absorption capacity of coated and uncoated swab

Analysis criteria	Mean percent recovery by swab*					
	HydraFlock®, uncoated	HydraFlock®, coated	PurFlock® Ultra, uncoated	PurFlock® Ultra, coated	Nylon flocked	ESwab
Recovery						
Pooled data-by swab type	93 (A)	81 (A)	54 (B)	89 (A)	88 (A)	88 (A)
By organism						
H. influenzae	103 (AB)	88 (B)	90 (B)	86 (B)	119 (A)	119 (A)
N. gonorrhoeae	103 (A)	78 (BC)	75 (C)	87 (B)	89 (B)	89 (B)
S. pneumoniae	97 (A)	77 (C)	31 (D)	89 (AB)	82 (BC)	84 (BC)
P. anaerobius	69 (BC)	82 (AB)	19 (D)	93 (A)	63 (C)	58 (C)
	Mean percent water absorption*					
Water absorption by						
Whole swab	18.8±0.97	17.9±1.02	21.6±0.99	17.9±0.92	14.2±1.12	13.2±0.35
Swab head fibres	676 (A)	ND§	571 (B)	ND§	671 (A)	ND§

ND§: Not determined, *Letters in parentheses denote significance. Levels not connected by the same letter are significantly (P<0.05) different

extraction of microorganisms by the capillary action from the collection site and prevents dehydration of organisms on the swab.

Recovery of test bacteria from coated and uncoated swabs was statistically analysed in two different ways, from culture studies data. The pooled recovery of *H. influenzae, N. gonorrhoae, S. pneumoniae* and *P. anaerobius* from all coated and uncoated swab types was 119%, 89%, 82% and 63%, respectively, with significant differences. However, recovery of all bacteria (pooled data) by swab type showed no significant differences between coated and uncoated swabs of any type, except for uncoated PurFlock® Ultra, which was the lowest (54%) and significantly different from the rest [Table 1]. Coating has no effect on the recovery of *H. influenzae* from Nylon, PurFlock® Ultra swabs. Uncoated HydraFlock® exhibited the highest recovery of *N. gonorrhoeae* and *S. pneumoniae*. Coated versions of both PurFlock® Ultra and HydraFlock® swabs gave significantly higher recovery of *P. anaerobius* than the rest [Table 1].

Discussion

Efficient uptake and release of microorganisms is an important criterion for selecting of a swab to improve the diagnostic sensitivity[1] that may compensate for the losses due to poor viability, few microbes in the specimen, small sample volume, and prior antibiotic therapy. Pre-treatment of swabs with biopolymers such as alginate, proteins (vegetable or animal), or serum (horse or bovine) is reported to minimise the inactivation of microbes on the swab, desiccation and toxic factors.[5-8,11] Incorporation of proteins on the swab may protect sensitive organisms and provide necessary stability after the swab carrying microbes is transferred to a transport medium; however, presence of extraneous proteins can potentially permit overgrowth of commensals. Considering the only known difference of protein coating between ESwab *vs* Nylon Swab of Copan and coated *vs* uncoated HydraFlock® or PurFlock® Ultra swabs of Puritan, significant differences in recovery of majority of test bacteria are evident between coated and uncoated swabs of Puritan only, and they are not evident between Nylon and ESwab. In general, the overall collection and release performance upon protein coating had a positive, negative and no effect on PurFlock® Ultra, HydraFlock® and Nylon swabs, respectively. This may be attributed to the nature of coating material used and the physico-chemical properties of synthetic swab head fibres.

Conclusion

The overall collection and release performance of all bacteria from uncoated HydraFlock® swabs is superior to or on par with Nylon and ESwab, although uncoated PurFlock® Ultra swabs performed poorly. On the similar lines, higher water absorption of swab tip fibres of uncoated HydraFlock® that potentially prevents desiccation of microbes, coupled with overall superior collection and release of test bacteria among test swabs is likely to be the choice for clinical diagnostics. Although the study did not address the viability of test bacteria over time, it sheds light on the value of protein coating on collection and release of clinically important pathogens under the test conditions. Protein coating of swab tips did not uniformly demonstrate higher recovery compared with their uncoated counterparts; however, protein solublisation from the swab tip in the transport media might help to stabilise some organisms and it may also provide nutrients for the growth of commensals during transport.

Acknowledgements

The work was conducted at CET LLC, Winston-Salem, NC, USA facility. The work was funded by Puritan Medical Products Co. LLC.

References

1. Miller JM, Holmes HT. Specimen collection, transport, and storage. In: Murray PR, Baron ES, Pfaller MA, Tenover FC, Yolken RH, editors. Manual of Clinical Microbiology. 7th ed. Washington: ASM Press; 1999. p. 33-63.
2. Rose L, Jensen B, Peterson A, Banerjee SN, Arduino MJ. Swab materials and *Bacillus anthracis* spore recovery from nonporous surfaces. Emerg Infect Dis 2004;10:1023-9.
3. Verhoeven P, Grattard F, Carricajo A, Pozzetto B, Berthelot P. Better detection of *Staphylococcus aureus* nasal carriage by use of nylon flocked swabs. J Clin Microbiol 2010;48:4242-4.
4. Hernes SS, Quarsten H, Hagen E, Lyngroth AL, Pripp AH, Bjorvatn B, *et al*. Swabbing for respiratory viral infections in older patients: A comparison of rayon and nylon flocked swabs. Eur J Clin Microbiol Infect Dis 2011;30:159-65.
5. Ross PW. The isolation of *Streptococcus pyogenes* from throat swabs. J Med Microbiol 1977;10:69-76.
6. Norrod P, Williams RP. Stability and viability of Neisseria gonorrhoeae in various solutions and buffers. Appl Environ Microbiol 1979;37:293-7.
7. Hirchman JS, Perry JL. Modification of swab applicators providing full compliance with NCCLS standard M40-A. 2004; C164; 104th ASM General Meeting in New Orleans, LA. 104th ASM General Meeting. Washington: ASM Press.
8. Jerris RC, Jarrett DK, Cherney W. Comparison of StartSwb II with BD culture MaxV (+) transport systems for preservation of bacterial pathogens important in pediatric medicine: *Hemophilus influenzae, Streptococcus pneumoniae, and Neisseria meningitides*. ASM 105th General Meeting in Atlanta, GA. ASM 105th General Meeting. Washington: ASM Press; 2005. p. C300.
9. Harry KH, Turner JC, Madhusudhan KT. Comparison of physical and clinical performance characteristics of selected swabs. Afr J Microbiol Res 2013; 7:4039-48.
10. Sall J, Creighton L, Lehman A. JMP Statistics: A guide to statistics and data analysis using JMP. Cary: SAS Publishing; 2007. p. 5-600.
11. Perry JL. Assessment of swab transport systems for aerobic and anaerobic organism recovery. J Clin Microbiol 1997;35:1269-71.

How to cite this article: Harry KH, Madhusudhan KT. Effect of protein coating of flocked swabs on the collection and release of clinically important bacteria. Indian J Med Microbiol 2014;32:301-3.

Source of Support: Puritan Medical Products Co. LLC, **Conflict of Interest:** None declared.