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MUC 5AC mucin expression in adenoid tissue in relation to otitis media with effusion

Tanya K. Meyer, Joseph E. Kerschner*

Department of Otolaryngology and Communication Sciences, Medical College of Wisconsin and Children's Hospital of Wisconsin, 9000 West Wisconsin Avenue, Milwaukee, WI 53226, USA

Abstract

Background: Mucins function in the normal physiology of the middle ear and in the pathophysiology of otitis media with effusion (OME). The adenoid is felt to play a role in otitis by serving as a bacterial reservoir and propagating the inflammatory state of the middle ear. We wished to determine the MUC 5AC mucin gene expression in the adenoids of children with and without OME. *Methods*: Adenoid specimens were collected from children with and without OME ($n = 14$) and MUC 5AC expression quantitated using RT-PCR. *Results*: This demonstrated a normalized value of 44.8 au $\pm$ 53.8 for MUC 5AC in children with OME and 159.8 au $\pm$ 97.2 for MUC 5AC in children without OME ($p = 0.02$). *Conclusions*: Although mucin accumulation in the middle ear causes morbidity (hearing loss) in children, our results suggest there is less MUC 5AC expression in the adenoids of children with OME as compared to those without OME. These results emphasize the role of mucin in normal physiology and host defense, and may implicate defects in mucociliary transport, Eustachian tube function, or quality of mucin rather than quantity of mucin produced in the pathophysiology of otitis media.

Keywords: Mucin; Otitis media; Adenoid

1. Introduction

Variation in the quantity and character of middle ear secretions and specifically mucin production is known to be important in the pathophysiology of otitis media [1]. Mucin production can be stimulated by inflammatory conditions [2], and the adenoid, as a bacterial reservoir, can propagate this inflammatory state [3]. Further study of the relationship

* Corresponding author. Tel.: +1-414-2666476; fax: +1-414-2666989.
E-mail addresses: tmeyer@mcw.edu (T.K. Meyer), kersch@mcw.edu (J.E. Kerschner).

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between inflammatory cytokines, mucin production, and mucin gene expression will provide a better understanding of the pathophysiologic mechanisms in otitis media.

Nine distinct human mucins have been identified, and are differentially expressed according to tissue type. Tracheobronchial epithelium has been shown to express MUC 5AC [4], Eustachian tube epithelium expresses MUC 5AC and MUC 5B [5], and the middle ear epithelium expresses mainly MUC 5B. We wanted to determine whether the MUC 5AC mucin gene was differentially expressed in adenoid tissue among individuals with and without otitis media with effusion.

2. Material and methods/patients

Specimen collection and research protocol was approved by the research and publications committee and Human Rights Review Board of the Children's Hospital of Wisconsin. Total RNA isolated using Qiagen mini RNeasy columns from homogenated adenoid specimens was incubated with DNAse, precipitated, and quantitated by spectrometry. Three micrograms of DNA free RNA was used in positive and negative reverse-transcriptase reactions, and subsequent template used to perform quantitative radioactive PCR amplification of MUC 5AC and GAPDH targets. MUC 5AC expression was normalized to GAPDH amplification.

3. Results

Fourteen specimens were collected, eight from children undergoing adenoidectomy for OME and six from children undergoing adenoidectomy for upper airway obstruction

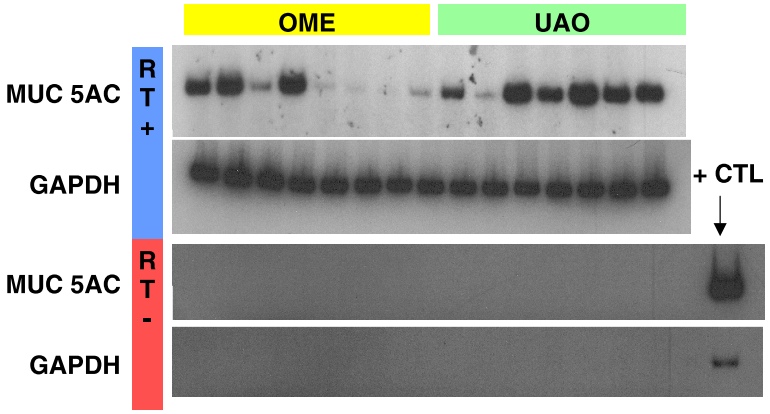

Fig. 1. Differential Expression of MUC 5AC between pediatric adenoid tissue of children with upper airway obstruction (UAO) versus otitis media with effusion (OME). The yellow bar indicates mucin and GAPDH expression from adenoid samples removed for OME, and the green bar for UAO. The upper two panels (blue bar) are for reverse transcribed samples, and the lower two panels (red bar) are reverse transcriptase negative controls confirming the absence of genomic amplification.

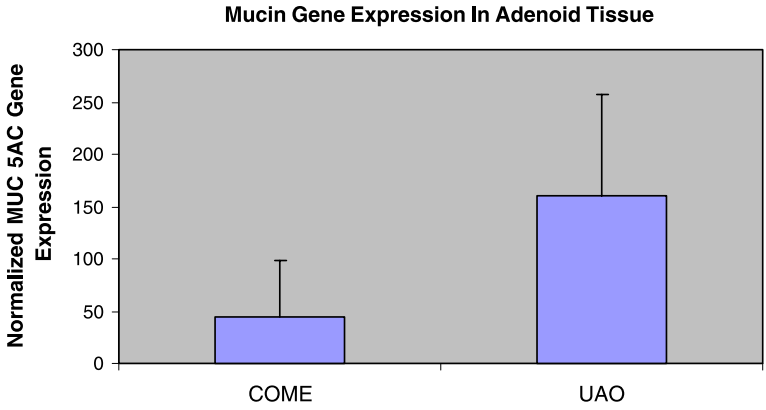

Fig. 2. Graphic illustration of the normalized MUC 5AC gene expression between adenoid samples of children with OME verses UAO. Quantitative RT-PCR of mucin expression demonstrated a normalized value of 44.8 au ± 53.8 for MUC 5AC in children with OME and 159.8 au ± 97.2 for MUC 5AC in children with UAO ($p = 0.02$).

(UAO). Individuals with both diagnoses were excluded. These groups were balanced in age and sex distribution. Quantitative RT-PCR of mucin expression demonstrated a normalized value of 44.8 au ± 53.8 for MUC 5AC in children with OME and 159.8 au ± 97.2 for MUC 5AC in children without OME ($p = 0.02$). GAPDH amplification was equivalent between groups, and reverse-transcriptase negative reactions showed no amplification. See Figs. 1 and 2.

4. Discussion

Mucins play multiple roles in the physiology of the nasopharynx and middle ear. In this study we show that MUC 5AC is differentially expressed in the adenoid tissue of children suffering from OME compared to children with UAO. Although mucin accumulation in the middle ear causes morbidity (hearing loss) in children, our results suggest there is less MUC 5AC expression in the adenoids of children with OME as compared to those without OME. Specifically, children with OME express MUC 5AC approximately 3.5 fold less than children with UAO ($p = 0.02$). Although otitis and glue ear are traditionally thought of as states of excess mucin, this study suggests that this relationship may be more complicated, at least with respect to mucin expression in the nasopharynx. It has been demonstrated that nasopharyngeal mucin is important in bacterial adherence in the nasopharynx, impacting colonization and host defenses and acute and chronic infectious processes in this area [6]. Thus, it is likely that either excess or deficiency of specific mucin types may impact an individual's response to pathogens, affect Eustachian tube function, middle ear inflammation and acute and chronic otitis media. Future studies will look at other mucin sub-types and their expression patterns in the nasopharynx and the potential relationship of this expression to otitis media.

Acknowledgements

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References

[1] J.E. FitzGerald, G.G. Green, F.W. Stafford, et al., Characterization of human middle ear mucus glycoprotein in chronic secretory otitis media (CSOM), Clin. Chim. Acta 169 (2–3) (1987) 281–297.
[2] K.C. Kim, K. McCracken, B.C. Lee, et al., Airway goblet cell mucin: its structure and regulation of secretion, Eur. Respir. J. 10 (11) (1997 Nov.) 2644–2649.
[3] G.A. Gates, C.A. Avery, T.J. Prihoda, Effect of adenoidectomy upon children with chronic otitis media with effusion, Laryngoscope 98 (1) (1998 Jan.) 58–63.
[4] C.J. Reid, S. Gould, A. Harris, Developmental expression of mucin genes in the human respiratory tract, Am. J. Respir. Cell Mol. Biol. 17 (5) (1997 Nov.) 592–598.
[5] J. Lin, V. Tsuprun, H. Kawano, et al., Characterization of mucins in human middle ear and Eustachian tube, Am. J. Physiol. Lung. Cell Mol. Physiol. 280 (6) (2001 Jun.) L1157–L1167.
[6] J.M. Bernstein, Waldeyer's ring and otitis media: the nasopharyngeal tonsil and otitis media, Pediatric Otorhinolaryngol. 49 (1999) S127–S132 (Suppl.).