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Kissing, saliva exchange, and transmission of *Neisseria gonorrhoeae*

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Abstract

Data from mathematical models suggest that kissing and saliva exchange during sexual activity might be major contributors to community gonorrhoea morbidity. Although there is little evidence to support this, it provokes discussion of the potential role of the oropharynx in gonorrhoea control. Improved sensitivity and ease of diagnostic testing, as well as increased screening for extragenital infections among men who have sex with men, have increased awareness of the high frequency of oropharyngeal gonorrhoea. However, there are insufficient data to determine the mechanisms of transmission for these infections. Innovative studies that use quantitative microbiological techniques are needed to accurately assess how oral gonorrhoea or saliva exchange in infected people contribute to the morbidity of gonorrhoea in the community. More empirical data on pharyngeal gonorrhoea infections, and the role of transmission to and from the oropharynx, are needed to inform prevention planning.

Introduction

Kissing, particularly so-called deep kissing (which involves saliva exchange) has been suggested to play a major role in the transmission of gonococcal infections and to be an important contributor to community gonorrhoea morbidity.[1,2] Although there is no doubt that oropharyngeal infection with *Neisseria gonorrhoeae* occurs, or that infection can be transmitted during oral sexual activities to cause urogenital, rectal, and presumably oral infections, the relative contribution of *N gonorrhoeae* to overall gonococcal morbidity, as well as whether saliva exchange (rather than more direct mucosal contact) is a major vehicle for gonorrhoea transmission, is far from proven and remains an important topic for further research. In this Personal View, we briefly summarise our present understanding on the detection and prevalence of oropharyngeal gonorrhoea. We also express what we believe is a justifiable scepticism regarding the hypothesis that exchange of saliva accounts for up to as much as 70%[1] of all gonococcal infections among men who have sex with men (MSM) and

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Declaration of interests

We declare no competing interests.

question the available evidence concerning the amount of morbidity attributable to oropharyngeal gonorrhoea. Finally, we suggest a research agenda that could help to address this important topic.

Morbidity

Most pharyngeal gonococcal infections are asymptomatic and there are few proven direct sequelae that can be attributed to pharyngeal gonorrhoea. Thus, the greatest contribution of pharyngeal infection to community gonococcal morbidity relates to the potential contributions of infections transmitted from the pharynx to other sites of the body that are more typically associated with infectious complications (such as pelvic inflammatory disease and epididymitis). Pharyngeal gonococcal infections are also hypothesised to contribute to morbidity by continuing the development of gonococcal antimicrobial resistance and by potentially increasing the risk of HIV transmission and acquisition. There are few local complications of pharyngeal gonorrhoea[3,4] and the infection is self-limited. The average duration of untreated infection is also unclear. In a study of culture-proven gonococcal pharyngitis,[5] 55% of infections cleared on their own when untreated infected patients were retested a week or more after an initial positive screening culture. By contrast, a more recent study[6] that used a more sensitive nucleic acid amplification test (NAAT) found that only 139 (11%) of 1266 infected patients no longer had detectable nucleic acids present when retested 7–14 days following initial detection of infection. Further evaluation of the duration of infection and spontaneous clearance of untreated pharyngeal gonorrhoea with both culture and NAATs are needed. Pharyngeal gonorrhoea has also been associated with an increased risk of disseminated gonococcal infection. However, disseminated gonococcal infection is a rare complication of infection.[3,4]

Prevalence

For more than 50 years it has been well established that *N gonorrhoeae* can colonise the oropharynx. Numerous studies of culture confirmed pharyngeal gonorrhoea done in the late 1970s and early 1980s described infection prevalence of 3–6% among heterosexual men, 10–20% among heterosexual women, and 10–25% among MSM.[3,4,7–10] In 10–40% of infected people, the pharynx was the sole site of infection.[8,11,12] These studies also showed an association between pharyngeal infection and the practice of fellatio and suggested that, although cunnilingus might also lead to infection, the number of cases observed was low for cunnilingus and the efficiency of transmission was assumed (on the basis that there were higher reported rates for infections attributed to fellatio compared with cunnilingus) to be lower for this sexual act compared with fellatio. More recently, with the advent of NAATs for gonorrhoea detection, testing for oropharyngeal infection has become easier to do and is more sensitive.[11] Numerous studies now reaffirm that substantial numbers of people at risk of gonorrhoea have pharyngeal gonorrhoea and that, in a large proportion of people infected, the oropharynx is the sole site of infection.[8,11,12]

In the USA, western Europe, and Australia, the reported rates of gonorrhoea have increased among MSM in the past two decades, particularly compared with heterosexual men. MSMs are a group who, on average, might have higher rates of oral exposure during sex.[13] In

addition, in the USA, after nearly 20 years of stable gonorrhoea prevalence, proportions again began to increase at rates similar to increases not seen since the mid-1960s, in part due to increases in infections among MSM.[13] Few data are available on pharyngeal gonorrhoea prevalence among people other than MSM.

Transmission

With this background, investigators led by Christopher Fairley explored the role of kissing and saliva exchange as potential contributors to community gonorrhoea morbidity. A mathematical model created by the group has led to their proposal that, among MSM, about 30% of urethral and over 90% of rectal infections, can be attributed to salivary transmission.[1] The findings of this model must be tempered with limitations of the implicit assumptions.[14] For example, the model assumes that because most cases of gonococcal urethritis are symptomatic, people who are infected would curtail sexual activity and seek care soon after symptom onset. However, this assumption would not be the case for pharyngeal gonorrhoea; because this infection is typically asymptomatic, there would be prolonged opportunities for transmission to others. This assumption is inaccurate for a substantial portion of men with gonococcal urethritis. We have shown that over 25% of men seeking care for gonococcal urethritis at a public sexually transmitted diseases clinic had had sex since the onset of symptoms.[15] This faulty assumption regarding the proportion of urogenital gonococcal infections that are symptomatic, and that infected men curtail sexual activity following symptom onset, is essential to the convergence (the ability of a mathematical model to run) and stability of the Zhang model.[1]

Factors affecting transmission

Not all exposures to people with gonorrhoea lead to infection.[3] Detection of gonorrhoea in the oropharynx could represent recent exposure in the absence of active infection, infection with bacterial concentrations insufficient to lead to transmission, or active transmissible infection. For transmission of gonorrhoea to occur, there must be sufficient numbers of viable *N gonorrhoeae* present to lead to infection. With exposure to increasing concentrations of organisms, infection is more likely to occur. The models that have been used to support the contention that saliva is an appropriate vehicle for gonorrhoea transmission are based on data obtained through use of highly sensitive NAATs that are more sensitive than culture but might be detecting organisms present in low concentrations.[11,12] In addition, although another study[5] did show that the gonococcus can be cultured from saliva, organisms present in saliva might not be highly infectious because of the relatively hostile environment that saliva represents (due to the numerous enzymes, antibodies, and other antibacterial substances present in saliva).[16,17]

Empirical data for transmission of gonorrhoea from one person to another through kissing is sparse. Wallin and Seigal[18] reported that none of nine sexual partners of people with culture-proven pharyngeal gonorrhoea had gonorrhoea despite frequent mouth-to-mouth contact. Weisner and colleagues[4] did not specifically study the prevalence of simultaneous pharyngeal gonorrhoea among sexual partners. However, they found no couples for whom simultaneous pharyngeal cultures were the only manifestation of gonorrhoea. They also

mentioned that, of five hetero sexual men who had pharyngeal gonorrhoea in their study, three men with both pharyngeal and urethral gonorrhoea had female sexual partners with pharyngeal infection.[4] Another study[19] suggested that gonorrhoea can be transferred between a couple by kissing, but does not adequately rule out other forms for transmission, such as oral–genital contact, which might represent treatment failures because both infections in the study (urogenital and pharyngeal sites) required repeated treatment. Another study[20] also suggested that pharyngeal gonorrhoea infection can occur through sharing of sweets with an infected patient. However, this study also did not rule out sexual exposure.

Research agenda

In summary, the scientific evidence is not sufficiently robust to support the claim that oropharyngeal gonorrhoea is a major driver of community gonorrhoea morbidity, nor that the vehicle for transmission of oropharyngeal gonorrhoea is saliva. However, these claims do identify several areas that deserve more scientific attention. Reappraisal of the prevalence and morbidity associated with pharyngeal gonorrhoea, as well as the duration of infection at the pharynx, are appropriate and badly needed areas for study. Not all exposures to viable organisms lead to infection, thus studies specifically designed to study transmission efficiency for both direct and indirect (ie, saliva mediated) exposures are needed. Only when such data are available can improved modelling of the role of pharyngeal gonorrhoea and saliva exchange be done. Such research needs to begin with organisms known to be viable and should use both culture and NAAT testing (preferably quantitative assays) to address pharyngeal prevalence in the entire population at risk, and not limiting the study to only MSM. Data for the location in the oropharynx where infection occurs (and the most appropriate sample for testing) are needed, as are studies quantifying the concentrations of *N gonorrhoeae* at different sites within the oropharynx. Further studies are needed of oropharyngeal gonorrhoea prevalence in the regular sexual partners of people for whom pharyngeal infection is the only manifestation of infection. Also, better collection of data related to deep kissing and use of saliva for lubrication during vaginal and anal sex are also warranted. Such studies should explore how often pharyngeal infections are present in both members of couples and address estimates of the frequency and variety of kissing, as well as the amount of oral sexual exposure that occurs. Finally, since most individuals at sexually transmitted disease clinics are present because of a recent sexual exposure, more studies should be done in settings other than sexually transmitted disease clinics, in which kissing not in the context of other riskier sexual activities might be more common.

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