HELICOBACTER PYLORI TRANSMISSION: IS IT DUE TO KISSING?

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ABSTRACT

Helicobacter pylori (*H. pylori*) has been associated with the pathogenesis of chronic active gastritis, peptic ulcer disease[1] and gastric carcinoma.[2] Understanding the exact mode of transmission of *H. pylori* is essential in order to limit its spread and serious diseases associated with it. Living on human and ectopic gastric mucosa, the organism has not been convincingly isolated from other animals. Most infections are acquired in childhood and some of the risk factors associated with childhood infection include poor sanitation, overcrowding and lower socioeconomic status.

The theory of direct person-to-person spread is now generally accepted, but the route of transmission remains open to conjecture. No predominant route of transmission has been defined and the possibilities include faecal-oral, oro-oral and gastro-oral. *Helicobacter pylori* has been identified in saliva and in swabs taken from the oral cavity through molecular techniques. It remains unclear whether the bacteria detected represented colonisation of the oral cavity or transient regurgitation of the micro-organisms from the stomach into the mouth during the process of gastro-oesophageal reflux. Gastro-oral or oro-oral routes could be important in the transmission of the infection from mothers to children and between siblings.

It is unlikely that *H. pylori* could be transmitted between spouses. Most married couples demonstrate little concordance of bacterial strain as typed by molecular techniques and treated patients are seldom re-infected by their untreated infected spouses.

INTRODUCTION

The epidemiology of *H. pylori* infection has been extensively studied for many years but there is still uncertainty about the exact mode of transmission of the organism within the community. After being told that their ulcers or gastritis are due to *H. pylori* infection patients will often ask the following questions:

- how did I get the infection?;
- can I pass the infection to my partner or family members?; and
- will I get the infection back after treatment?

This article reviews the epidemiology and possible routes of transmission of *H. pylori* with particular emphasis on the oro-oral mode of transmission.

INCIDENCE AND EPIDEMIOLOGY

Helicobacter pylori infection occurs throughout the world with an estimated 50% of the world's population being infected with the organism. There is a higher prevalence in developing countries. In developed countries, the prevalence of infection in children under ten years of age is approximately five to ten per cent,[3, 4] but this prevalence increases to around 70% in those over 70 years of age.[5] In contrast, a much higher prevalence of up to 80% has been reported in developing countries[3, 6] with most of the population infected by the age of ten years.[3,7] The initial acquisition of *H. pylori* infection is rare in adults,[8] with seroconversion rates being 0·33–0·5% per person-year, be it in developed or developing countries.[9] Therefore, the increase of prevalence with age is unlikely to be due to progressive acquisition of the organism over time, with most investigators now believing that this increase in prevalence with age is more likely to be due to a cohort phenomenon. It is proposed that infection occurs mostly in childhood and the decreased prevalence in younger cohorts in developed countries may reflect improved living conditions for children in recent years. With the gradual improvement in living standards, there is a corresponding reduced transmission of the infection.[10] The increased prevalence in older members of the population is due to the fact that socioeconomic conditions in most developed countries were less satisfactory 40–50 years ago than they are today. There is little age-related increase in prevalence with age in developing countries because the transmission of infection already occurs at a high rate in children. Children are more susceptible to the infection because of their lack of knowledge about matters of hygiene and their increased susceptibility during episodes of achlorhydria induced by gastroenteritis.

SOURCES AND RESERVOIR OF THE INFECTION

Apart from human gastric mucosa, the organism has also been found in ectopic gastric mucosa such as in Barrett's oesophagus, and ectopic gastric mucosa in a Meckel's diverticulum. However, humans appear to be the only natural host for *H. pylori*. A number of animals (pigs, sheep and cats) have been suspected of harbouring *H. pylori* in their stomachs, but the spiral organisms identified by more discriminating molecular techniques often proved to be *Helicobacter* species that were closely related to, but different from, *H. pylori*.[11]

Water supplies[12] and food[13] may be also be sources of infection. Boiling water has not been shown to protect

the Chinese against high infection rates,[14] but it has been demonstrated that *H. pylori* can survive in water for up to four days only.[15] Lack of regulatory genes in the *H. pylori* organism implies that the organism cannot survive for long periods outside its normal environment.[16]

RISK FACTORS

The socioeconomic status of a subject during childhood has been found to be an important determinant for the development of *H. pylori* infection.[7, 17, 18] Indices of low socioeconomic status such as crowded living conditions, bed sharing, poor sanitation and lack of domestic hot water have all been shown to be risk factors for *H. pylori* infection. Large sibship size and closer age gap between siblings[19] have also been shown to be predictors for infection.

The prevalence of *H. pylori* is higher in close communities[20] and in members of the same family[21] groups than in the general population. Children from families in which the parents were infected, especially the mothers, had significantly higher rates of infection than children with no infected parents.[21,22] This positive association between children and their parents has been found only to be significant for the mothers in an isolated and rural population in Guatemala;[23] it was hypothesised that mothers spent longer times with their children at home while the fathers worked in the fields. All these observations lend support to the theory of direct person-to-person transmission, mainly through close contact with other infected children and family members. If the strong association of infection were due to exposure to common environmental sources one would not expect any difference in the strength of the associations between maternal and paternal infection status with the children's *H. pylori* status.

ROUTES OF TRANSMISSION

How does a bacterium that lives in an acid environment, but that cannot survive when exposed to room air, pass from one stomach to another? With the failure to identify another reservoir for *H. pylori* outside the human body, the theory of direct person-to-person spread is now generally accepted but the route of transmission remains open to conjecture. It is generally agreed that the organism gains entry to the stomach via the mouth. Marshall[24] and Morris[25] both successfully induced gastritis in themselves by ingesting the organism. No predominant route of transmission has been defined and the possibilities include faecal-oral,[26] oro-oral[27] and gastro-oral (contact with vomitus or gastric secretions).[28] Transmission may be indirect, involving vehicles such as contaminated food or water.

Faecal-oral

Helicobacter pylori may not be able to exist in a viable form in faeces as the organism is sensitive to the lethal effects of bile acids during its passage through the gastrointestinal tract. Fresh stool specimens are required and it appears that the organisms can only be cultured from individuals with accelerated gut transit time, such as malnourished Gambian children[26] or adults with provoked catharsis.[29] *Helicobacter pylori* has been detected in swabs taken from under the fingernails.[23] Diarrhoea is a common childhood ailment and, coupled with reduced awareness of hygiene in children and the liking for putting objects into their mouths, the faecal-oral route of transmission can take place through sharing of food or toys touched by contaminated fingers. Indeed, *H. pylori* has also been detected in breast milk suggesting that the organism may survive on nipples or fingers to contaminate milk.[30] It appears that the faecal-oral route of transmission can only happen in the presence of close contacts with infected individuals. On a macro level of faecal-oral transmission, there has been no outbreak of infection associated with contamination of water supplies. Viral hepatitis A is a disease transmitted through the faecal-oral route but the decline in the prevalence *H. pylori* infection has not been found to correlate with the decline of hepatitis A infection.[31]

Gastro-oral

Gastro-oral transmission has been postulated in young children, among whom vomiting and gastro-oesophageal reflux are common. The vomitus could act as medium of transmission. *Helicobacter pylori* has been cultured from the vomitus and air in the vicinity of vomiting from infected individuals.[29] Infection could occur through ingestion of food or exposure to objects contaminated with vomitus colonised by *H. pylori.*

Healthcare workers in general are at increased risk of acquiring *H. pylori.* Gastroenterologists, endoscopists and nurses have all been shown to be at higher risk of *H. pylori* infection.[32] In particular, gastrointestinal endoscopists have been shown to have higher prevalence of the infection.[33, 34] Oral infection via microscopic droplets of gastric juice produced during manipulation of the endoscopes is believed to be the mode of transmission; using surgical gloves was not found to be protective.[33] Furthermore, gastroenterologists are at much higher risk compared to chest physicians who performed bronchoscopy, as the latter were not exposed to gastric secretion.[35] There should be no risk of patient-to-patient transmission by endoscopy as the organism is readily killed by most commonly used disinfectants.[36]

Oro-oral

Data in support of oro-oral transmission (kissing or the pre-mastication of food given to babies as practised by mothers from some ethnic backgrounds) are derived from a variety of observations. Whether *H. pylori* may permanently or transiently infect the mouth in dental plaque and/or saliva remains unresolved. Technical problems remain the main stumbling blocks in resolving the issue with controversies in sampling, culture and

polymerase chain reaction (PCR) techniques. The findings of identical strains of *H. pylori* in the mouth and stomach support the hypothesis that the oral cavity may be a reservoir of the bacteria.[37,38] The PCR method has proved to be more successful for the detection of oral *H. pylori,* with positivity of up to 90%, as reported recently by Madinier *et al*.[39] However, *H. pylori* has rarely been cultured from the mouth. In attempts to isolate the organism from the oral cavities of 120 patients, none of these patients' saliva or dental plague grew the organism even though 47% showed colonisation in the stomach by the organism.[40] Oral specimens have a much more complex microflora which may inhibit the growth of *H. pylori*, thus accounting for the lack of isolation from the oral cavity. The role of organisms detected by PCR is unclear in terms of viable transmission. Caution should be exercised when identifying putative *H. pylori* isolates from the oral flora by PCR methods due to the risk of misidentification if the primer used is not specific for *H. pylori*. The detection of *H. pylori* in the oral fluids and cavity in some patients could be due to occasional transitory regurgitations of the micro-organisms from the stomach into the mouth during the process of gastro-oesophageal reflux and does not support colonisation of oral cavity by the micro-organism.

If the oral cavity is colonised with *H. pylori*, then close person-to-person contact in members within the same family can facilitate oro-oral transmission. Recent studies reported clustering of *H. pylori* infection among family members[21,41] and spouses.[42,43] Analysis of DNA fingerprints using repetitive extragenic palindromic PCR (REP-PCR) of *H. pylori* isolates from the same family members showed that they were genotypically similar.[44] Use of chopsticks for eating by Chinese people has been shown to be associated with a higher prevalence of the infection in family members.[45] Higher prevalence of the infection among West African children whose mothers chew their food before feeding them during infancy indicated that saliva may be a vector for transmitting the organism.[46] Oro-oral transmission may also occur by the common use of spoons, the licking of pacifiers or the teats of feeding bottles.

Another mechanism for the oro-oral mode of transmission is through kissing. If spouse-to-spouse transmission of *H. pylori* infection occurs frequently, then this route of transmission could be the major cause for re-infection or recrudescence in individuals who have received eradication therapy. Recent guidelines from the European consensus report[47] and the North American report[48] do not recommend contact tracing and eradication therapy for spouses of *H. pylori* individuals.

Parente *et al.*[42] reported that having a *H. pylori* positive partner with a duodenal ulcer may increase the risk of *H. pylori* colonisation. However, the investigators performed only a seroprevalence study and did not identify strains of *H. pylori* from gastric biopsies. Georgopoulos *et al.*[43] reported that 56% of the partners of *H. pylori* positive patients with a duodenal ulcer harboured the same strains of *H. pylori* as their spouses, as determined by the ribotyping method with 16S rRNA, the conserved part of its genes. However, the range of *H. pylori* strains in their locality that could be distinguished by the molecular techniques was not known. It is therefore possible for two partners in a marriage to be infected with the same strain of *H. pylori* by chance during their childhood, indicating a common source of infection rather than oro-oral transmission between the partners.

Through the use of DNA fingerprinting methods a large genetic heterogeneity is demonstrated among *H. pylori* strains isolated from individual patients. Generally most individual patients harbour a single dominant *H. pylori* strain with a unique DNA fingerprint even if specimens have been taken from multiple gastric sites.[49–51] In cases of treatment failure, similar restriction fragment length polymorphism (RFLP) types are present after treatment.[52] However, a minority of patients could be infected with multiple strains.[51,53] Strains from different individuals have different genotypes, though there is clustering of the same genotype in individuals from the same families.[44]

Using the technique of polymerase chain reaction-restriction fragment length polymorphism (PCR-RFLP) on *ureC* and *ureB* gene, Suzuki *et al.* showed that in 21 out of 70 couples both partners were infected with *H. pylori*.[54] However, only one of these 21 couples showed the same PCR-RFLP pattern. Our study showed that amongst spouses of *H. pylori* infected patients, only 51% tested positive serologically for the infection. The organisms isolated in these spouses were not identical to the index cases as distinguished by the PCR-RFLP method.[55] This finding supports the observation of Suzuki *et al.* in that *H. pylori* infection is unlikely to be transmitted between partners. This conclusion can be further supported by other indirect findings. Studies on reinfection after treatment for *H. pylori* are also informative in relation to transmission. Treated patients have not been shown to be reinfected by their untreated infected spouses.[56] The risk of reinfection in adults after successful eradication has been shown to be low in both developed[57] and developing countries.[58]

There could be several possible reasons for the low rate of transmission (if any) between spouses. First, the concentration of *H. pylori* in the oral cavity of infected patients may not be of an adequate concentration to infect their partners. Second, the organisms in the oral cavity may not be viable for propagation. Third, adults are less sensitive than children to *H. pylori* infection, as suggested by the acquisition rate of only 0·3% per year in adults even when they were exposed in high prevalence areas.[9] Specific conditions, such as transitory gastric achlorhydria encountered during gastroenteritis

in childhood may be required for gastric infection unless an overwhelmingly large amount of micro-organism is ingested.

CONCLUSIONS

Despite extensive epidemiological research, the precise mode of transmission of *H. pylori* infection has not yet been firmly established. Most infections are acquired in childhood and risk factors associated with childhood infection include poor sanitation, overcrowding and lower socioeconomic status. Direct person-to-person spread is now generally accepted but the route of transmission remains open to conjecture. The relative importance of the faecal-oral, gastro-oral and oro-oral routes of transmission has not been defined. The gastro-oral route may be an important route of transmission, especially in children. Vomiting is a common ailment in children and *H. pylori* contained in vomitus could be passed from one child to another due to a lack of awareness of hygiene in this age group. The oro-oral route may be an important one in the transmission from mothers to children. Transient colonisation in the mouth could occur in mothers with free reflux and *H. pylori* could be passed from mothers to their children during the process of chewing or tasting their children's food. Oro-oral transmission or kissing between spouses appears to be an unlikely route of transmission based on evidence of low rate of reinfection in treated adults exposed to infected partners and genotypic study of the micro-organisms.

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