Breast feeding and the risks of viral transmission

Specialised epidermal secretions developed as nutritious and bacteriostatic factors some 120 million years ago; milk production has proved a crucial factor to mammalian survival in a wide range of habitats. Milk composition differs considerably between phyla, within species, and with time in an individual lactating mother. The neonatal period claims the greatest infectious toll in mammals so that from an evolutionary standpoint there must be a balance in favour of producing and consuming milk without increasing susceptibility to infection. Competitive interaction with viruses, bacteria, and protozoans has resulted in the development of unique characteristics within breast epithelial cells. Unlike equivalent cells in sweat or salivary glands, they secrete nutritive molecules, antibiotic substances, growth factors, inflammatory cytokines, and chemokines while regulating a physiological recruitment of lymphoid and myeloid cells from the circulation into the milk. Milk therefore has functions other than nutrition; milk is a complex mixture of cells, membranes, and molecules. Epidemiological data from the HIV pandemic have highlighted our lack of knowledge about this secretion.

It was established in the 1960s that milk was a significant source of infection to mouse pups for Moloney leukaemia virus, sarcoma virus, and mammary tumour virus: other species show similar patterns of transmission of lentiviruses. In man the RNA retroviruses including HIV-1, HTLV-1, and HTLV-2 are all transmitted by this route. It has been recorded that HIV-2 is not transmitted by breast milk, but it is probable that there is a relatively lower risk in this less virulent retrovirus as well as fewer data to assess infectivity. Cytomegalovirus is possibly the most commonly detectable virus in milk: it is thought that reactivation of virally infected breast epithelial cells in early lactation promotes the shedding of infectious free virus particles. Rubella, herpes simplex, and rarely hepatitis B can be passed on to the infant too if mothers have an active infection. EBV and HHV6 may be found in human milk, but large serological studies suggest that they rarely infect the breast fed neonate. Hepatitis C RNA has not been detected in milk in one series, and the infection rate by this route is probably low unless the maternal viral load is high.

The challenge to clinicians is therefore to determine the risk to any particular infant of milk borne infection: can one estimate the hit rate of these organisms in milk? Reports from various populations show a range of infectious rates for cytomegalovirus (40–76%), rubella (25–50%), HTLV-1 (80%), and HIV-1 (5–66%). A meta-analysis approach estimated an additional risk of 14% (95% confidence interval 7–22%) of mother to child HIV infection conferred by breast feeding; an increased risk of 26% (95% CI 13–39%) for incident cases. These wide ranges of hit rates indicate a complexity in the underlying process of transmission which merit clarification.

Given the volume of milk consumed daily by an infant it is surprising that milk is not more infectious, and there are clearly strong protective factors at work. At present there are insufficient data to rank known risk factors most likely to increase maternal infectivity or infant susceptibility (table 1), let alone disease severity. Milk constituents vary considerably between mothers, and over time in a single woman, rendering many objective measures impractical. Milk composition is influenced by gestation, treatment with steroids, or psychological stress: the interactions between these events and the roles of breast epidermal cells remain unclear.
activated cells (dendritic cells in particular) and mediators known to induce viral replication in breast epithelium and activate infant enterocytes. The same may be true of subclinical mastitis. The comparative significance of these observations has to be determined, but active management of clinical mastitis offers mothers, midwives, and doctors an opportunity to reduce the risks of vertical viral transmission. Enhancing maternal nutrition (perhaps with trace elements, vitamins, and antioxidants) or enhancing genetic resistance to reduce subclinical or clinical mastitis through diet or medications will diminish the risks of milk borne viral transmission.25

Can breast milk be cleared of viruses? In the case of retroviruses, might milk be washed as may semen in order to remove active virus? Although one might conceivably remove cell associated virus by filtering, free viral particles are difficult to eliminate. Pasteurisation to 62.5°C will destroy infectious viral particles, but this also alters milk protein composition to a significant degree, and in practical terms is often limited by the requirement for scrupulous hygiene.26 27 Protective mechanisms of the innate and cellular immune system at work during lactation could remove cell associated virus by filtering, free viral particles are di


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