Effect of non-suckling on the pH of breast milk and its possible relationship with breast cancer

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Summary

The pH of breast milk was determined in 10 lactating mothers after interrupting suckling from one of the breasts, alternately for 120 hr during the 1st, 12th and the 16th postpartum weeks. The milk from the unsuckled breasts had a slightly higher pH at all three times, being slightly alkaline as compared with the suckled breasts from which the milk was slightly acidic. There were differences also between the three diurnal feeds, the pH being higher in the last diurnal samples. If this temporary experimental stoppage of breast feeding is akin to decline of breast feeding, the changes in the pH of breast milk caused by it may provide clues to the mechanism of the long-suggested possible carcinogenic effect of a fall in the prevalence of breast feeding. An alkaline milieu surrounding epithelial cells causes hyperplasia, cell atypia and a marked increase in mitotic activity, changes which are a prelude to neoplasia. The causative relationship of late age at first birth does not find support in the thesis of the alkaline milieu in the aetiology of breast cancer presented here.

Introduction

It has been suggested that an alkaline milieu surrounding epithelial cells plays an important role in carcinogenesis of epithelial surfaces (Malhotra, 1967, 1970, 1976, 1977a,b). Although the long-suggested influence of lactation and breast feeding has been questioned by some workers, notably MacMahon and his group (MacMahon *et al.*, 1970 a,b; Yuasa and MacMahon, 1970; Lowe and MacMahon, 1970), it seemed relevant to compare the pH of breast milk from the suckled and the unsuckled breast in view of the differences between the two, noted in an earlier study (Malhotra, 1977a).

In the present study the pH of breast milk in 10 lactating mothers was measured during the first,

twelfth and the sixteenth week after delivery, after stopping suckling for 120 hr from one of the breasts.

Subjects and methods

Subjects

On the sixth postpartum day, 10 co-operative lactating mothers randomly selected from the maternity wards, with normal full-term deliveries, were randomly placed in two groups of five each. Neither the mothers nor their infants were taking any medicines, and were well.

The mothers in one group were instructed not to suckle their babies from the left breast for 120 hr; and the other group from the right breast. At the end of the experimental period of 120 hr, 5 ml of breast milk were extracted from each breast separately with an Egnell breast pump. The sequence of laterality of the breasts was then reversed and at the end of the next 120 hr 5 ml of breast milk were similarly extracted separately from each breast. Samples were taken at the three diurnal feeds since two pilot studies had shown that the differences between the pH of the milk from the suckled as compared with the unsuckled breast tended to be greater towards the later diurnal feeds. The experimental procedure was repeated in the 12th and 16th postpartum weeks.

Methods

The pH of the breast milk samples was determined immediately after collection with the Beckman pH meter using glass electrodes.

Results

Three mothers were excluded from study in the first week due to the need to suckle, or extrusion of milk from both breasts. All the mothers, however, co-operated during the remaining two periods, i.e. the 12th and 16th weeks.

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Mean pH of breast milk in pH units

The mean pH values for the breast milk from the unsuckled breasts were significantly higher (analysis of variance) as compared with the milk from the suckled breasts in all the three periods (Table 1). The differences between the mean values of the two types of milk were 0.93, 0.75 and 1.04 during the 1st, the 12th and the 16th week respectively.

TABLE 1. Mean pH of milk from the suckled and unsuckled breasts in 10 lactating mothers during the 1st, 12th and the 16th week after delivery (six milk samples from each mother at each time)

Time interval	Suckled breasts		Unsuckled breasts		P value
	Mean	± s.d.	Mean	± s.d.	
1st week (n=42)*	6.88	0.91	7.81	1.0	<0.01
12th week (n=60)	7.15	1.12	7.90	1.14	<0.02
16th week (n=60)	6.71	1.2	7.75	1.4	<0.01

*Results from only seven mothers in the first week.

Distribution of samples of milk in different pH ranges

There were more samples in the higher pH ranges (pH >7.4, alkaline reaction) and fewer in the lower pH ranges (pH <7.4, acidic reaction) in the unsuckled breast as compared with the samples from the suckled breast for all the three periods combined (Table 2). This was highly significant ($P<0.001$, χ^2 test).

Validity of the results

Three diurnal samples were taken as it was seen in the pilot studies that the differences between the pH of milk from the suckled as compared with the unsuckled breasts were greater towards the later parts of the day. This is also seen in the present study (Table 3). The reasons for this are totally unclear and its significance not known.

Discussion

The mechanism by which the pH of breast milk undergoes a shift towards alkalinity if the breast is not suckled during lactation is unclear. During normal lactation and breast-feeding, the breast milk is slightly acidic with a pH range of 6.88 to 7.15.

This loss of acidity is nevertheless relevant because

TABLE 3. Comparison of the pH of breast milk samples between the three diurnal feeding schedules: 6 a.m., 10 a.m. and 6 p.m., in ten lactating mothers

	(n)	Suckled breast		Unsuckled breast		P value
		Mean	± s.d.	Mean	± s.d.	
6 a.m.	54	7.12	0.84	7.75	0.91	<0.02
10 a.m.	54	6.75	0.98	7.84	0.89	<0.001
6 p.m.	54	6.76	0.81	7.9	1.0	<0.001

in an alkaline milieu, epithelial cells are damaged (James, 1957; Ball and James, 1961). As a result of this the cell undergoes hyperplasia, marked cell atypia and a striking 40-fold increase in mitotic activity in gastric mucosa (Lawson, 1964; du Plessis, 1965). Dunham, Muir and Hamner (1966) produced similar changes in hamster cheek pouches by repeatedly painting with an alkaline solution of calcium hydroxide. Dunham, Sheets and Morton (1974) induced similar changes leading to carcinoma *in-situ* in hamster cheek pouches and oesophagus by treating them with quids of plant extracts, such as arecoline and calcium hydroxide. Arecoline alone failed to produce any lesions. Shanta and Krishnamurthi (1963), Hirayama (1966) and Malhotra (1967) suggested that it was the alkaline slaked lime and not tobacco in the betel leaf quid which was responsible for such changes leading to cancers of the buccal cavity and the oesophagus. There is also evidence which shows that cancer of the cervix uteri may also be produced by a similar mechanism of the interaction between an alkaline seminal fluid and the epithelial cells of the portio of the cervix. Seminal fluid is rendered alkaline by frequent sexual intercourse (Malhotra, 1971). Cancer of the colon also appears to be due to a similar mechanism of increased alkalinity (Malhotra, 1967, 1977b, 1981, 1982a,b; Thornton, 1981). The thesis of the alkaline milieu (Malhotra, 1976) can also explain why cancer of the lung is more common in sufferers of chronic bronchitis where the ciliated respiratory epithelium changes into goblet cells. On coming into contact with cigarette smoke, which is alkaline (Malhotra, 1970), these cells undergo similar changes of marked hyperplasia, cell atypia and an increase in mitotic activity. Such pre-cancerous changes have been noted in smokers' lungs. Hyperplasia is a prelude to neoplasia (Poel, 1964).

Breast feeding and high parity have long been

TABLE 2. Distribution of 162 milk samples in different pH ranges

pH	5.6-6.0	6.1-6.5	6.6-7.0	7.1-7.5	7.6-8.0	8.1-8.5	8.6	Total
Suckled breast	9	12	35	9	15	1	0	81
Unsuckled breast	0	4	8	23	24	11	11	81

considered as protective against cancer of the breast (Lane-Claypon, 1926; Bagg, 1925; Wainright, 1931; Khanolkar, 1967; Haagesen, 1971). Contrary to this are the findings of MacMahon and his colleagues (MacMahon *et al.*, 1970a; MacMahon *et al.*, 1970b; Yuasa and MacMahon, 1971; Lin, Chen and MacMahon, 1971; Mirra, Cole and MacMahon, 1971). These authors have considered late age at first birth to be the dominant risk factor and excluded decline of breast feeding as a cause (Yuasa and MacMahon, 1970). But recent studies from Sweden (Adami *et al.*, 1978), Canada (Choi *et al.*, 1978), Burma (Thein-Hlang and Thein-Maung-Myint, 1978), Iceland (Tulinus *et al.*, 1978) and from Maryland (Craig, Comstock and Leiser, 1974) are in conflict with the findings of MacMahon and his colleagues regarding the role of age at first birth specifically. These studies found no relationship whatever between age at first birth and the risk of developing cancer of the breast. The reasons for these contradictory findings and interpretations are not readily clear and caution is necessary in this particular area of breast cancer research.

Some recent studies from Arab Countries—Sudan (Daud *et al.*, 1965), Saudi Arabia (Sterling and Alfadli, 1981), Uganda (Templeton, 1973) and Libya (Malhotra and Abudejaja, 1980) are also at variance with the suggestion that early age at first birth is protective. In these countries first birth in the teens is the rule rather than the exception, yet cancer of the breast is the second most common malignancy in women, after cancer of the cervix (Sterling and Alfadli, 1981). The frequency of these malignancies of the breast seem to be on the increase in these countries side by side with a continuous decline in breast feeding and a concomitant increase in bottle feeding (El Radhi, Wasti and Majeed, 1981; Abudejaja, Malhotra, Mehgoob and Khan, 1981, unpublished data).

Cole and MacMahon (1969) have postulated that the relative levels of individual oestrogen fractions produced in the first decade or so after puberty are important determinants of a women's life-time breast cancer risk. They suggest that the first pregnancy induces irreversible changes that either render the breast tissue itself less susceptible to induction of cancer, or reduce the carcinogenic stimulus to the breast (MacMahon *et al.*, 1970a). Morgan *et al.* (1978) obtained contradictory results in oestrogen profiles in young women with a maternal breast cancer history. More studies on hormone profiles are urgently needed, especially from areas in the Arab world where age at first birth is low and yet breast cancer incidence is high. The hormone thesis, with which is linked the age at first birth, fails to explain many epidemiological features of cancer of the breast, among which is the universal observation of

the striking preponderance of the involvement of the left breast (McManus, 1977).

On the other hand, the pH thesis explains all the known features of this disease including the striking preponderance of the involvement of the left breast in most published series. It has been noticed that this is predominantly so in the case of right-handed women. The few cases that we came across in whom the lesion started in the right breast were left-handed women. The reasons for this are not clear but two surveys showed that it was the practice among right-handed women to nurse their infants with the right breast before the left. This is likely to produce alkalinity of the breast milk in the left breast since this practice may result in partial non-suckling of the left breast. Highly conjectural but nevertheless probable, this needs further investigation since it is possible that the right-handed mothers would find it natural and convenient to support the heavier head end of the infant on their right arms.

In the present state of knowledge, a great deal of caution is necessary to separate the two current, contradictory and debatable views: (1) 'Evidence now has accumulated to the point where the lactation hypothesis may be discarded' (Vakil and Morgan, 1973); (2) 'I cannot ignore the basic truth that in ethnic groups breast feeding appears to protect against breast cancer, and I believe it is my duty as a physician to advise breast feeding and to do all I can to help women to succeed with it' (Haagesen, 1971).

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