ORIGINAL

Relationship between mammary gland structures during pregnancy and breast-feeding

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Abstract

Study Purpose

Diagnostic indices for prediction of breast milk production and assessment of care necessary for mammary gland structure during the pregnancy period were investigated.

Methods

Development of mammary gland during the pregnancy period was examined via ultrasound methodology. Each subject underwent three measurements once per trimester. Quantity of post-partum breast milk production was also measured ; furthermore, the relationship between mammary gland image and production quantity was evaluated.

Results and conclusion

As previously reported, mammary gland reaches a certain level of development during the course of pregnancy. Four distinct types of developmental pattern were observed. Mammary gland exhibited remarkable development up to the15th week of pregnancy in comparison with non-pregnant adult females in type 1. In type 2, mammary gland displayed significant development from the 16th to the 35th week of pregnancy. In types 3 and 4, mammary gland tissue development, which was apparent from 35 weeks, was characterized by gland thickness of > 20 mm and < 20 mm, respectively. Among these four types, type 1 mammary gland demonstrated the largest level of breast milk production. Therefore, we suggest that understanding with respect to mammary gland structure during pregnancy contributes toward individual support in breast-feeding following childbirth.

Key words : mammary gland structure, breast-feeding, ultrasound

Introduction

"Concerning Healthy Parents and Children 21"[1] suggests four major challenges in maternal and child health in the 21st century. The second challenge is "To ensure a safe and comfortable pregnancy / Childbirth and assistance for infertility". One of the specific objectives in terms of attaining this goal includes "breast-feeding-only nursing". This objective also states "the system should be constructed with education and support for breast-feeding-only childcare, as well as appropriate backup for formation of strong affection between a mother and a child. However, mothers who are incapable of adequate breast-feeding should not be put under pressure." Childcare delivered via breast-feeding-only is a wish for many mothers. In reality, however, breast-

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feeding is also a cause of anxiety over proper childcare for many mothers as well. For this reason, numerous studies have been conducted regarding breast-feeding from the perspectives of the mother and the child[2),3)].

The ratio of breast-feeding has shown some improvement since a tremendous drop that occurred during the 1970's ; however, it has not reached the high breast-feeding ratio observed in the 1960's. In terms of the functional aspect of breast-feeding, hormones involved in breast milk production and the mechanism of milk production itself have been confirmed. Structurally, developmental changes influenced by mammary gland configuration and hormones have been identified. However, the relationship between gland structure and post-birth breast-feeding was scarcely investigated ; in Japan, only one report appears in the literature[4)]. In order to determine proper prognosis with respect to the mother's preparedness for breast-feeding as well as delivery of necessary care, understanding of the mammary gland structure and estimation of the relationship between gland structure and breast milk production are essential. The purpose of this study was to examine diagnostic indices for prediction of breast milk production and assessment of care necessary for mammary gland structure during the pregnancy period.

Methods

1. Subjects

Subjects were 102 women who delivered a single baby vaginally at term. The average of the subjects was 28.7 years old, which was compatible to the average age of mother in Japan (29.6 years old). The numbers of primipara and multipara in the subjects were 60 and 42, respectively. The study institute is the third medical facility averaging 400 deliveries per year. Our institute provides proper care targeting improvement of breast-feeding ratio via incorporation of "The ten steps to successful breast-feeding".

This study was performed from April to December 2001.

2. Ethical Consideration

The aims and significance of this study were informed to the mothers with an explanatory note and their consent was obtained. The records obtained in this study were carefully stored.

3. Methods and Analysis

Development of mammary gland during the pregnancy period was investigated via ultrasound tomography (LP probe at 7.5 MHz) (RT-FINO, Yokogawa medical, Tokyo, Japan). Each subject underwent three measurements once per trimester. Measurements were conducted in the outer region surrounding mammary papilla on the "better arm" of each participant in the dorsal position. Mammary gland images were imported using an scanner (Epson ES-8000, Epson, Tokyo, Japan), followed by evaluation with image analysis software (Mac SCOPE, Mitani CO., Fukui, Japan).

Area ratio of the mammary gland area was analyzed under the supervision of a breast diagnostic specialist. Milk feeding amount was estimated on the basis of measurements of the child's body weight before and after feeding, e.g., in terms of the difference.

ANOVA and chi-square test were used to determine statistically significant differences. Differences were considered significant it $P<0.01$.

Results

1. Mammary gland growth pattern

Differences in mammary gland growth pattern were recognized among individual subjects. Change in mammary gland structure during pregnancy was investigated on a per-individual basis. As a result, four types of growth pattern were established (Figure 1, Table 1).

Table 1 The mammary gland development pattern

The mammary gland development pattern	Number of pregnant women (n=102)
Type 1	60/102(58.8%)
Type 2	13/102(12.8%)
Type 3	21/102(20.6%)
Type 4	8/102(7.8%)

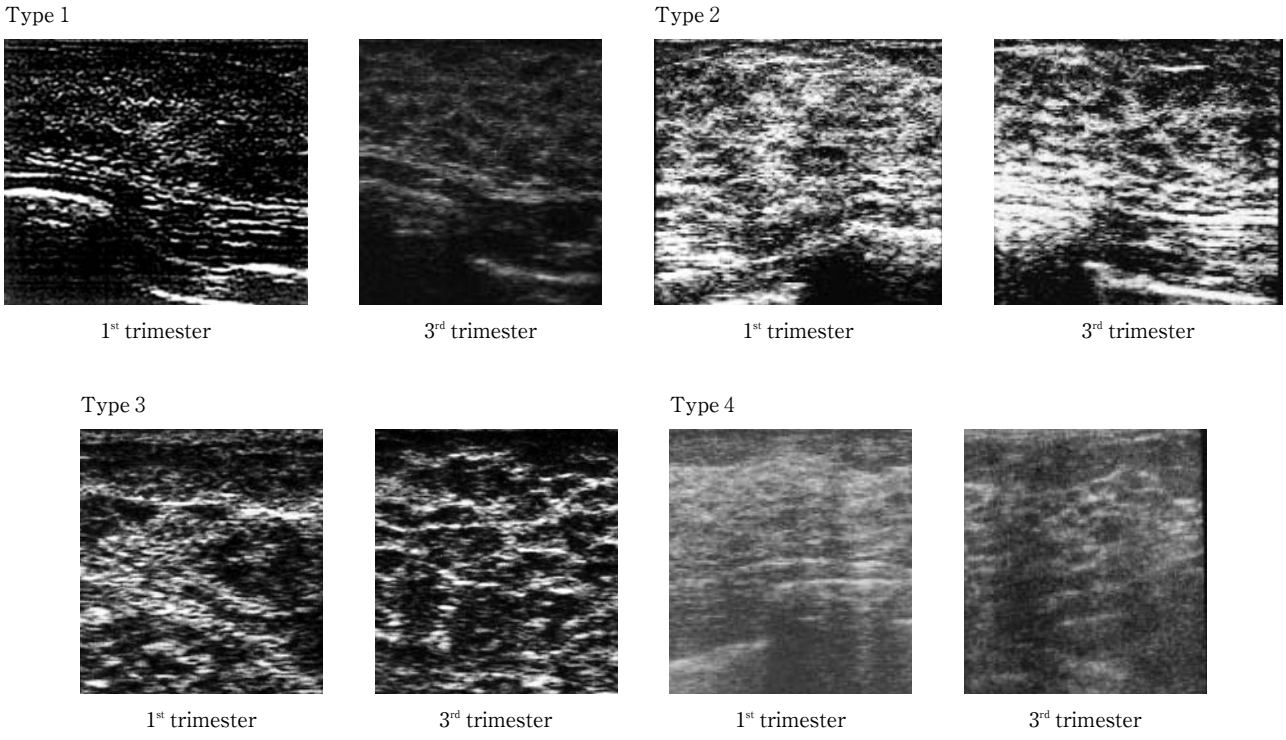

Figure 1 Four type of growth pattern of mammary gland structure

In type 1, remarkable mammary gland development up to the 15th week of pregnancy was observed in comparison to non-pregnant adult females[5]. Mammary gland displayed significant development from the 16th to the 35th week of pregnancy in type 2. In types 3 and 4, mammary gland tissue development, which was apparent from 35 weeks, was characterized by gland thickness of > 20 mm and < 20 mm, respectively. Distribution of subjects in terms of type was as follows : type 1 : 58.8%, type 2 : 12.8%, type 3 : 20.6%, and type 4 : 7.8%.

There were no significant differences of mammary gland thickness between primipara and multipara.

2. Mammary gland tissue condition after 36 weeks of pregnancy

Mammary gland tissue condition after 36 weeks of pregnancy was analyzed in the four growth types on the basis of thickness and mammary gland area (specified area in scanned image). Mammary gland thickness was as follows : type 1 : 24.8±3.0 mm, type 2 : 23.0±3.0 mm, type 3 : 23.0±3.0 mm, and type 4 : 17.0±2.0 mm. Mammary gland from the type 4 group demonstrated significantly less thickness than that of the type 1 group ($p<0.01$). Tissue area from type 1 mammary gland also revealed more advanced development (Table 2).

Table 2 Condition of antenatal mammary gland after 36 weeks

	n	Average of thickness (mm) (mean±SD)	Average of area (mm^2) (mean±SD)
Type 1	60	24.8±3.0	5680±760
Type 2	13	23.0±3.0	4520±842
Type 3	21	23.0±3.0	4842±642
Type 4	8	17.0±2.0*	3342±784

*$p<0.01$ compared with Type 1 by ANOVA

3. Relationship between mammary gland growth pattern and breast milk production

Breast milk production on the 5th day after birth was investigated on the basis of mammary gland growth type. 54.9% of subjects delivered breast milk exclusively by nursing by the 5th day post-partum. Ratios of breast milk-only nursing by type are as follows : type 1 : 70.0%, type 2 : 53.9%, type 3 : 33.3%, and type 4 : 0%. The type 1 group, which demonstrated more advanced

Table 3 Relationship between mammary gland growth pattern and breast-feeding (post partusm 5 days)

	n	Only breast-feeding n(%)	Mixed n(%)	Bottle-feeding n(%)
Type 1	60	42/60(70.0%)	14/60(23.3%)	4/60(6.7%)
Type 2	13	7/13(53.9%)	6/13(46.1%)	0/13(0.0%)
Type 3	21	7/21(33.3%)	13/21(61.9%)	1/21(4.8%)
Type 4	8	0/8(0.0%)*	6/8(75.0%)	2/8(25.0%)
Total	102	56/102(54.9%)	39/102(38.2%)	7/102(6.9%)

*$p<0.01$ compared with Type 1 by chi-square test

mammary gland growth from early pregnancy, exhibited a significantly higher ratio ($p<0.01$) of breast-feeding (Table 3).

Discussion

With ultrasound imaging, mammary gland tissue can be visualized by high-density echography. Several subjects displayed steep image expansion in the first and the second trimesters ; additionally, other subjects exhibited similar image expansion from the second to the third trimester. Mammary duct and interstitium images, which appeared as random low-density echo images evident in mammary gland tissue, also expanded during the third trimester. On the whole, enlargement of mammary gland was apparent.

In contrast, echo images from the type 4 group failed to demonstrate large change until prior to delivery. It has been reported that mammary gland structure development during pregnancy is completed in the third trimester. However, completeness of development is difficult to determine by ultrasound. In the present investigation, most of the participants (92.2%) displayed additional thickness in mammary gland tissue (average ; 20 ± 2.7 mm) ; high-density echo-image revealed enlargement in association with decreased adipose tissue in comparison to mature non-pregnant women.

Kasai and Suzuki[4] classified acinar duct and interstitium from mammary gland echo-diagnosis during pregnancy into six distinct types. Their findings indicated that only 5.2% of subjects exhibited change in these patterns between early and late stages of pregnancy. These data also demonstrated no significant change in mammary gland thickness. In contrast, the present study revealed expansion of high-density echo images from mammary gland tissue per each subsequent measurement. In addition, elevated acinar cell numbers occurred as multiple porphyritic low-density echo images.

In terms of the relationship between mammary gland structure and breast milk production, breast-feeding-only nursing was conducted most efficiently in the type 1 group, which demonstrated significant development in mammary gland from the early stage of pregnancy. In contract, no subjects from the type 4 group, which displayed a lesser degree of mammary gland development, conducted breast-feeding-only child care. Kasai and Suzuki[4] documented subjects characterized by very thin interstitium, obscure acinar cells and mammary gland thickness of less than 10 mm exhibiting inadequate breast milk production. These mammary gland structure characteristics can be employed as prediction indices for estimation of post-partum breast milk production. This practical implication also suggests that nursing mothers can gain information during pregnancy for decision-making regarding feeding methodology for their children. Furthermore, documentation of their own mammary gland development via imaging contributes to the mother's motivation and emotional incentive with respect to breast-feeding childcare.

Additionally, support for mothers characterized by type 4 criteria, in which inadequate breast milk production is projected, can be implemented during their pregnancy period. At present, the greatest challenge involves support for women from the type 4 group regarding successful breast-feeding.

Conclusion

Four distinct patterns in mammary gland development were observed. The type 1 group, which demonstrated more advanced mammary gland growth from early pregnancy, displayed superior breast milk production. The present results imply that understanding of mammary gland structure during pregnancy contributes to individual support and care in breast-feeding following

childbirth.

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