Preliminary Report on Influence of Vitamin B₁ and Glucose Injected into Mammary Gland on Lactation and Arakawa's Reaction.

177th Report of the Peroxidase Reaction.
(124th Human Milk Study.)

By

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Objects of investigation were lactating mothers without any other abnormality than insufficient lactation. To each of these women 30 c.c. of 4.5 % glucose with 0.5~1.0 mgrms. of vitamin B₁ were injected. The injection was performed into one or both mammary glands.

The amount of milk drunk by a nursing infant was determined by careful weighing of the infant immediately before and after the nursing. The duration of a single nursing on one side of the breast was 7 minutes; of course it was an arbitrary time. But it is well known that most of mothers' milk is drunk within the first few minutes or 5~10 minutes.

Result of Experiment.

Case 1 (Cf. Table 1). Since confinement the mother had continued to take vitamin B₁ up to the treatment. The supply of breast milk was so scanty that her child was fed mostly artificially. It was breast-fed only once a day. On the first day that she visited our Dispensary, breast milk was scanty and milking (stripping) was very difficult. Arakawa's reaction was strongly negative. After the mammary injection above mentioned on the left side of the breast Arakawa's reaction showed a tendency to become positive on both sides of the breast. Stripping became easy from the 5th day on after the injection and a sense of tension was felt. From the 10th day on after injection the child was fed artificially only once a day due to an increased lactation. Even 6 days after the discontinuance of the injection, the amount of milk secretion did not decrease.

TABLE 1.
Influence of vitamin B₁ and glucose injected into mammary gland on
lactation and A r a k a w a's reaction.

Case 1. M. K., aged 48 days. Age of mother 25 years.

Date	Side of breast	A r a k a w a's reaction 0' 1' 2' 3' 4' 5'	Administration of glucose and vitamin B ₁ (intramammary)		Stripping	Sense of tension of mammary gland	Amount of milk
			Glucose (4.5 %) c.c.	Vitamin B ₁ mgrms.			
19. VII	R	— — — — —	(—)	(—)	difficult	—*	
	L	— — — — —	30	0.5	"		
20. "	R	— — — — —	(—)	(—)	"	±†	
	L	— — — — —	30	0.5	"	±	
21. "	R	— — — — —	(—)	(—)	"	±	
	L	— — — — —	30	0.5	"	±	
22. "	R	— — ± ± ± ±	30	0.5	"	±	
	L	— — — ± ± ±	30	0.5	"	±	
23. "	R	— + ± ± ± ±	30	0.5	easy	+‡	
	L	— — ± ± ± ±	30	0.5	"	+	
24. "	R	— + ± ± ± ±	30	0.5	"	+	7'=40
	L	— ± + ± ± ±	30	0.5	"	+	7'=20
25. "	R	— + ± ± ± ±	30	0.5	"	±	
	L	— ± + ± ± ±	30	0.5	"	+	
26. "	R	± ± ± ± ± ±	30	0.5	"	±§	
	L	± ± + ± ± ±	30	0.5	"	±	
27. "	R	± + ± ± ± ±	30	0.5	"	±	7'=40
	L	± + ± ± ± ±	30	0.5	"	±	7'=40
28. "	R	± + ± ± ± ±	30	0.5	"	±	7'=30
	L	± + ± ± ± ±	30	0.5	"	±	7'=30
29. "	R	± + ± ± ± ±	30	0.5	"	±	
	L	± + ± ± ± ±	30	0.5	"	±	
30. "	R	± + ± ± ± ±	30	0.5	"	±	7'=20
	L	± + ± ± ± ±	30	0.5	"	±	7'=30
31. "	R	± + ± ± ± ±	30	0.5	"	±	
	L	± + ± ± ± ±	30	0.5	"	±	
6. VIII	R	± + ± ± ± ±	(—)	(—)	"	±	7'=50
	L	± + ± ± ± ±	(—)	(—)	"	±	7'=40

Tension of mammary gland not felt *, slightly felt †, felt ‡, much felt §.

Case 2 (Table 2).

In spite of a frequent use of vitamin B₁ preparation the amount of breast milk was very scanty and artificial feeding was used. A r a k a w a's reaction was already positive before the injection. Stripping which was very difficult before the injection became easy from the 6th day after the injection and a sense of tension of mammary glands was felt even as late as the 4th day after the injection. The amount of milk increased remarkably after the injection.

Case 3 (Cf. Table 3).

In this case the mother used alternately breast milk and cow's milk, because breast milk was scanty. After the injection, A r a k a w a's reaction became positive. In this case milking (stripping) itself had not been difficult before the treatment. A sense of tension of mammary glands was felt on the 2nd day after the injection. The amount of milk increased slightly after it.

TABLE 2.

Influence of vitamin B₁ and glucose injected into mammary gland on lactation and Arakawa's reaction.

Case 2. S. F., Aged 24 days. Age of mother, 24 years.

Date	Side of breast	Arakawa's reaction 0' 1' 2' 3' 4' 5'	Administration of glucose and vitamin B ₁ (intramammary)		Stripping	Sense of tension of mammary gland	Amount of milk
			Glucose (4.5 %) c.c.	Vitamin B ₁ mgrms.			
13. VII	R	± ++ ## ## ## ##	(-)	(-)	difficult	-	7'=10
	L	± ## ## ## ## ##	(-)	(-)	"	-	7'=10
14. "	R	Milk could not be stripped	30	1.0	"	-	
	L		30	1.0	"	-	
15. "	R	"	30	1.0	"	±	
	L		30	1.0	"	±	
16. "	R	+ ## ## ## ## ##	30	0.5	"	+	
	L	± ++ ## ## ## ##	30	0.5	"	+	
18. "	R	± ## ## ## ## ##	30	0.5	"	+	
	L	± ## ## ## ## ##	30	0.5	"	+	
20. "	R	± ## ## ## ## ##	30	0.5	easy	+	7'=50
	L	± ## ## ## ## ##	30	0.5	"	+	7'=30
22. "	R	+ ## ## ## ## ##	30	0.5	"	++	
	L	+ ## ## ## ## ##	30	0.5	"	++	
24. "	R	+ ## ## ## ## ##	30	0.5	"	++	
	L	± ## ## ## ## ##	30	0.5	"	++	
26. "	R	+ ## ## ## ## ##	30	0.5	"	++	
	L	± ## ## ## ## ##	30	0.5	"	++	
28. "	R	+ ## ## ## ## ##	30	0.5	"	++	7'=50
	L	+ ## ## ## ## ##	30	0.5	"	++	7'=30
29. "	R	+ ## ## ## ## ##	30	0.5	"	++	7'=40
	L	+ ++ ++ ++ ++ ++	30	0.5	"	++	7'=40
3. VIII	R	+ ## ## ## ## ##	30	0.5	"	++	7'=40
	L	± ## ## ## ## ##	30	0.5	"	++	7'=40
8. "	R	+ ## ## ## ## ##	30	0.5	"	++	7'=30
	L	+ ## ## ## ## ##	30	0.5	"	++	7'=50
17. "	R	± ## ## ## ## ##	30	0.5	"	++	7'=40
	L	± ## ## ## ## ##	30	0.5	"	++	7'=50

TABLE 3.

Influence of vitamin B₁ and glucose injected into mammary gland on lactation and Arakawa's reaction.

Case 3. S. K., Aged 6 months. Age of mother, 27 years.

Date	Side of breast	Arakawa's reaction 0' 1' 2' 3' 4' 5'	Administration of glucose and vitamin B ₁ (intramammary)		Stripping	Sense of tension of mammary gland	Amount of milk
			Glucose (4.5 %) c.c.	Vitamin B ₁ mgrms.			
4. VIII	R	- ± ± ± + + +	30	0.5	easy	±	7'=30
	L	- + + + + + +	30	0.5	"	±	7'=10
5. "	R	- + ++ ++ ++ ++	30	0.5	"	++	
	L	± ++ ## ## ## ##	30	0.5	"	++	
6. "	R	- + ++ ++ ++ ++	30	0.5	"	++	7'=40
	L	± ++ ++ ## ## ##	30	0.5	"	++	7'=60

7. "	R	± ++ ## ## ## ##	30	0.5	"	++	7'=50
	L	± ++ ## ## ## ##	30	0.5	"	++	7'=40
8. "	R	+ ## ## ## ## ##	30	0.5	"	++	7'=40
	L	± ## ## ## ## ##	30	0.5	"	++	7'=50
9. "	R	± + ++ ## ## ##	30	0.5	"	++	7'=30
	L	± + ++ ## ## ##	30	0.5	"	++	7'=30
12. "	R	+ ## ## ## ## ##	30	0.5	"	++	7'=50
	L	+ ## ## ## ## ##	30	0.5	"	++	7'=50

Case 4 (Cf. Table 4).

Her secretion had been so insufficient for about one month, that her child was artificially fed, being breast-fed only once a day. From the 7th day on after the

TABLE 4.
Influence of vitamin B₁ and glucose injected into mammary gland on
lactation and Arakawa's reaction.

Case 4. I. I., aged 2 months. Age of mother, 24 years.

Date	Side of breast	Arakawa's reaction 0' 1' 2' 3' 4' 5'	Administration of glucose and vitamin B ₁ (intramammary)		Stripping	Sense of tension of mammary gland	Amount of milk
			Glucose (4.5 %) c.c.	Vitamin B ₁ mgrms.			
25. VII	R	— — — — —	30	1.0	difficult	—	
	L	— — — — —	30	1.0	"	—	
26. "	R	— — — — —	30	0.5	"	—	
	L	— — — — —	30	0.5	"	—	
27. "	R	— — — — —	30	0.5	"	—	7'=20
	L	— — — — —	30	0.5	"	—	7'=0
28. "	R	— — — — —	30	0.5	slightly	±	7'=30
	L	— — — — —	30	0.5	easy "	—	
29. "	R	— — — — —	30	0.5	"	±	
	L	— — — — —	30	0.5	"	±	
31. "	R	— — — — —	30	0.5	"	±	
	L	— — — — —	30	0.5	"	±	
1. VIII	R	— — — ± ± ±	30	0.5	easy	+	7'=30
	L	— — — — —	30	0.5	"	+	
2. "	R	— — ± ± ± ±	30	0.5	"	+	7'=20
	L	— — — — ± ±	35	0.5	"	+	7'=20
3. "	R	— — ± + + +	30	0.5	"	+	7'=20
	L	— — — — ± ±	30	0.5	"	+	7'=30
4. "	R	— ± + ++ ++	30	0.5	"	+	7'=30
	L	— — — ± + +	30	0.5	"	+	7'=20
5. "	R	— — ± + + +	30	0.5	"	++	7'=30
	L	— — — ± + +	30	0.5	"	++	7'=20
6. "	R	— ± + ++ ++	30	2.0	"	++	
	L	— — — ± ± ±	30	2.0	"	++	
7. "	R	— + + ++ ++	30	2.0	"	++	7'=30
	L	— — ± + + +	30	2.0	"	++	7'=40
8. "	R	— ± + ++ ++	30	0.5	"	++	
	L	— — ± + + +	30	0.5	"	++	
9. "	R	— + + ## ##	30	0.5	"	++	7'=50
	L	— — — ± + +	30	0.5	"	++	7'=40
10. "	R	— ± + ++ ##	30	0.5	"	++	7'=50
	L	— ± + + ++	30	0.5	"	++	7'=50
11. "	R	— — — — —					
	L	— — — — —					

injection Arakawa's reaction showed a tendency to become positive and stripping became easy. From the 8th day a sense of tension of mammary glands was felt. The amount of milk increased slightly. From the 10th day on after the injection her child was breast-fed as often as times, while artificial feeding was reduced to twice a day.

Case 5 (Cf. Table 5).

This mother, who had an apparently appropriate supply of breast milk until 3 months of age of her baby, was forced by a doctor to wean her child on account of its vomiting. The child recovered from this symptom, but went gradually toward a malnutrition when artificially fed. When the mother visited our Dispensary, her child, 9 months old, was very atrophic and the body weight was that of a normal child of 4 months of age. After the injection Arakawa's reaction showed a tendency to become positive, but later the reaction became again strongly negative.

TABLE 5.

Influence of vitamin B₁ and glucose injected into mammary gland on lactation and Arakawa's reaction.

Case 5. R. S., aged 9 months. Age of mother, 29 years.

Date	Side of breast	Arakawa's reaction 0' 1' 2' 3' 4' 5'	Administration of glucose and vitamin B ₁ (intramammary)		Stripping	Sense of tension of mammary gland	Amount of milk
			Glucose (4.5 %) c.c.	Vitamin B ₁ mgrms.			
10. VIII	R	— — — — —	30	0.5	difficult	—	
	L	— — — — —	30	0.5	"	—	
11. "	R	Milk could not be stripped	30	0.5	"	—	
	L		30	0.5	"	—	
12. "	R	"	30	0.5	"	—	
	L	"	30	0.5	"	—	
13. "	R	"	30	0.5	"	—	
	L	"	30	0.5	"	—	
14. "	R	"	30	0.5	"	—	
	L	"	30	0.5	"	—	
16. "	R	— — — — — ±	30	0.5	slightly easy	—	
	L	— — — ± ± ±	30	0.5	"	—	
17. "	R	— — — — — ±	30	0.5	"	—	7'=20
	L	— — — — ± ±	30	0.5	"	—	7'=10
18. "	R	— — — ± ± ±	30	0.5	"	—	7'=15
	L	— — ± ± ± ±	30	0.5	"	—	7'=15
19. "	R	— — ± ± ± ±	30	0.5	"	—	
	L	— — — ± ± ±	30	0.5	"	—	
20. "	R	— — ± ± ± ±	30	0.5	"	—	7'=30
	L	— — — ± ± ±	30	0.5	"	—	7'=10
22. "	R	— ± ± ± ± ±	30	0.5	"	±	7'=30
	L	— — ± ± ± ±	30	0.5	"	±	7'=10
23. "	R	— ± ± ± ± ±	30	0.5	"	—	7'=30
	L	— — — ± ± ±	30	0.5	"	—	7'=10
24. "	R	— + + + + +	30	0.5	"	—	
	L	— — + + + +	30	0.5	"	—	
25. "	R	— ± + + + +	30	0.5	"	—	7'=10
	L	— — ± ± + +	30	0.5	"	—	7'=20
30. "	R	— — — — —	(—)				
	L	— — — — —	(—)				

Stripping was very difficult and a sense of tension was not felt. An increase of the amount of breast milk was not seen.

Case 6 (Cf. Table 6).

The infant was nourished with rice as his main diet, besides breast feeding. As the infant was attacked by dyspepsia, his mother wished to resort to more breast-feeding. Stripping was easy, but a sense of tension of mammary glands was not felt. After the injection Arakawa's reaction became positive. A sense of tension of mammary glands was felt from the 4th day on after the injection. The amount of breast milk increased after it.

TABLE 6.
Influence of vitamin B₁ and glucose injected into mammary gland on
lactation and Arakawa's reaction.

Case 6. T. T., Aged 14 months. Age of mother, 26 years.

Date	Side of breast	Arakawa's reaction 0' 1' 2' 3' 4' 5'	Administration of glucose and vitamin B ₁ (intramammary)		Stripping	Sense of tension of mammary gland	Amount of milk
			Glucose (4.5 %) c.c.	Vitamin B ₁ mgrms.			
10. VIII	R	— — — — — ±	30	0.5	easy	—	7' = 20
	L	— — — — — ±	30	0.5	"	—	7' = 30
11. "	R	— + + + + +	30	0.5	"	±	7' = 40
	L	— ± ± ± ± ±	30	0.5	"	±	7' = 40
12. "	R	— + + + + +	30	0.5	"	±	7' = 30
	L	— + + + + +	30	0.5	"	±	
14. "	R	± ± ± ± ± ±	30	0.5	"	+	7' = 40
	L	± ± ± ± ± ±	30	0.5	"	+	7' = 40
16. "	R	± ± ± ± ± ±	30	0.5	"	+	7' = 60
	L	± ± ± ± ± ±	30	0.5	"	+	7' = 60
19. "	R	± ± ± ± ± ±	30	0.5	"	+	
	L	± ± ± ± ± ±	30	0.5	"	+	
22. "	R	± ± ± ± ± ±	30	0.5	"	++	7' = 70
	L	± ± ± ± ± ±	30	0.5	"	++	7' = 70

Case 7 (Cf. Table 7).

The mother breast-fed her infant, but she felt a slight decrease of a sense of tension of mammary glands. Arakawa's reaction was already positive before the injection. After the injection a sense of tension of mammary glands was felt more and milk secretion increased.

Comment and Summary.

The result of the present experiment was summarized in Table 8.

As is shown in Table 8, after the injection Arakawa's reaction of all the cases showed a tendency to become positive and a sense of tension of mammary glands was felt or felt more strongly than ever. Though Case 5 was an exception, I was able to improve in a certain grade milk secretion after this injection in Cases 2, 3, 4, 6 and 7.

TABLE 7.

Influence of vitamin B₁ and glucose injected into mammary gland on lactation and Arakawa's reaction.

Case 7. U. O., aged 4 months. Age of mother, 30 years.

Date	Side of breast	Arakawa's reaction 0' 1' 2' 3' 4' 5'	Administration of glucose and vitamin B ₁ (intramammary)		Stripping	Sense of tension of mammary gland	Amount of milk
			Glucose (4.5 %) c.c.	Vitamin B ₁ mgrms.			
11. VIII	R	+ # # # # #	30	0.5	easy	+	7'=40
	L	+ # # # # #	30	0.5	"	+	7'=30
12. "	R	Milk could not be stripped	30	0.5	"	++	7'=50
	L		30	0.5	"	++	7'=50
13. "	R	"	30	0.5	"	++	7'=20
	L		30	0.5	"	++	7'=40
14. "	R	+ # # # # #	30	0.5	"	++	7'=60
	L	+ # # # # #	30	0.5	"	++	7'=60
15. "	R	+ # # # # #	30	0.5	"	++	7'=60
	L	+ # # # # #	30	0.5	"	++	7'=50
23. "	R	+ # # # # #	30	0.5	"	++	7'=60
	L	+ # # # # #	30	0.5	"	++	7'=80
24. "	R	+ # # # # #	30	0.5	"	++	7'=20
	L	+ # # # # #	30	0.5	"	++	7'=50
25. "	R	+ # # # # #	30	0.5	"	++	7'=70
	L	+ # # # # #	30	0.5	"	++	7'=60

TABLE 8.

Results simplified.

No. of experiment	Arakawa's reaction before the injection						Time (number of days) up to the 1st change of reaction	Time (number of days) up to easy stripping	Time (number of days) up to a sense of tension	Increase of amount of breast milk
	0'	1'	2'	3'	4'	5'				
1	—	—	—	—	—	—	3	5	5	±
2	±	+	+	+	+	+	0	6	4	+
3	—	±	±	+	+	+	1	0	2	+
4	—	—	—	—	—	—	7	7	8	+
5	—	—	—	—	—	—	5(∞)*	∞†	∞†	No increase
6	—	—	—	—	±	±	1	0	4	+
7	+	+	+	+	+	+	0	0	1	+

* The reaction became strongly Arakawa-negative after the discontinuance of the injection.

† Stripping was very difficult in spite of the injection.

In that exceptional case—Case 5—the child had, before it came to our Dispensary, been weaned because of vomiting in its 3 months of age. After the injection Arakawa's reaction showed a tendency to become positive, but the reaction became strongly negative again after the discontinuance of

the injection. And there was neither a sense of tension nor an increase of milk secretion after the injection. The breasts of this mother were flattened and the injected solution (at least what appeared to be it) came out forcibly from the nipples. We may well suppose that such mammary glands as in Case 5 were in a state of atrophy. Vitamin B₁ was probably unable to exert any good effect. Such a total weaning as was performed in Case 5 should not have occurred because of the child's vomiting, unless accompanied by other serious symptoms; breast-feeding should have been continued with a large supply of vitamin B₁ to mother and child.

As above shown, it is interesting to see that the injection into a mammary gland increased milk secretion. It is not to be excluded that the sucking of an infant had something in some way or other to do with an increased lactation in the present experiment.

Conclusions.

Vitamin B₁ and glucose, injected into mammary gland of a mother with inadequate supply of breast milk, is of some beneficial effect upon her secretion of breast milk and tends to improve her Arakawa's reaction.

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Prof. Akira Sato.