Newly Developed Mecometer Method for Objective Assessment of Meconium Content

We developed a new method for an objective assessment of the meconium content in amniotic fluid. By establishing a standard scale through a serial dilution of a known amount of meconium into the amniotic fluid, we developed a new method 'mecometer' that can objectively measure the meconium content in meconium-stained amniotic fluid samples. The objectivity and reliability of this mecometer were verified by 300 student volunteers. At least 70% of the volunteers could objectively measure and digitally describe the meconium content in meconium-stained amniotic fluid samples. We believe our newly developed mecometer is a very simple, reliable, and portable method, not requiring any instruments.

Key Words : Meconium; Amniotic Fluid

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INTRODUCTION

Meconium-stained amniotic fluid (MSAF) is regarded as a risk factor of various perinatal problems (1-4). Interestingly, patients with thick meconium developed major problems more frequently than those with thin meconium (1). Usually, meconium content in amniotic fluid (AF) samples has been classified into 3 categories: thin or light, moderate, and thick or heavy (5). This assessment for meconium content entirely depended on the subjective observation by clinicians. Accordingly, although this subjective assessment does not cause serious problems, several methods for the objective assessment of meconium content have been proposed by several investigators (6-9). Among these, spectrophotometer and meconium-crit methods have been proposed as simple and reliable ones (8, 9). However, these methods require instruments that are not portable and this may be a serious drawback for clinicians. Actually, these methods have not been used in a routine practice.

Therefore, we developed a simple and portable method not requiring any instruments for the objective assessment of meconium content in AF, and verified the objectivity and reliability of the method. We call our new method as 'mecometer'.

MATERIALS AND METHODS

Establishment of a standard scale for the mecometer

AF was collected by amniocentesis from the normal preg-

nant women without any obstetric problems in the third trimester. Only the clear AF without any contaminants were used in this study. The collected AF from 10 pregnant women were stored immediately at 4°C. The AF were pooled and filtered for sterilization and removal of cells. Meconium was aseptically obtained from ten normal neonates within 24 hr after birth. The collected meconium were aseptically mixed well and weighed. A 10 g of meconium was added in 100 mL of AF and mixed thoroughly. This solution was stored at 4°C as a stock solution of MSAF. As shown in Fig. 1A, the stock solution was serially two-fold diluted in AF to establish a standard scale for the objective assessment of meconium content. To make MSAF samples to test the objectiveness and reliability of the mecometer, an unknown amount of meconium was added into AF and mixed well. According to the method of Molco et al. (8), absorbance of the standard scale and MSAF samples was measured at 420 nm. The optical density from the standard scale was linearly correlated with meconium content (correlation coefficient=0.980, $p=0.000$, Fig. 1B). An equation ($y=1.942-0.23x$) was deduced from this correlation and the meconium content of MSAF samples was calculated by this equation.

Tests for objectivity and reliability of the mecometer

We gave brief information about the mecometer to 300 students without any clinical experience, and let these students compare grossly the turbidity of MSAF samples with that of the standard scale of mecometer and describe the results on a report sheet. This was done in triplicate under the same condition. The meconium content of the MSAF

Fig. 1. (A) Example of mecometer for the measurement of meconium content in amniotic fluid. Meconium content was easily measured by comparing the turbidity of sample A, B, and C with that of the standard scale indicated as the number from 1 to 10. (B) Optical density of the samples (A-C) compared to that of the standard scale (●). Optical density of the standard scale was well correlated with meconium content ($r > 0.9$, $p = 0.000$). Meconium content of the unknown sample A, B, and C corresponded to that of number 4, 5, and 8 tubes of the standard scale, respectively.

Table 1. Summary of 300 volunteers' reports

Standard scale (Meconium content, mg/mL)	Sample (No. of students)*		
	A	B	C
1 (100)	0	0	0
2 (50.0)	0	0	0
3 (25.0)	12	0	0
4 (12.5)	276	30	0
5 (6.25)	12	246	0
6 (3.13)	0	24	12
7 (1.56)	0	0	48
8 (0.78)	0	0	210
9 (0.39)	0	0	18
10 (0.00)	0	0	12

*Meconium content of the sample A, B, and C measured by spectrophotometer corresponded to that of tube number 4, 5, and 8, respectively, as shown in Fig. 1B.

samples described by students was compared with that measured by the spectrophotometric method.

RESULTS

The results are presented in Table 1. The meconium content of the sample C measured by the spectrophotometric method was 0.78 mg/mL, which corresponded to that of the number 8 tube of the standard scale (Fig. 1B). 210 students (70%) measured the meconium content of the sample C accurately, while the remaining 90 students (30%) did not. The meconium content of the sample B measured by the spectrophotometric method was 6.25 mg/mL, which corresponded to that of the number 5 tube of the standard scale (Fig. 1B). 246 students (82%) measured the meconium content of the sample B accurately, while the remaining 54

students (18%) did not. The meconium content of the sample A measured by the spectrophotometric method was 12.5 mg/mL, which corresponded to that of the number 4 tube of the standard scale (Fig. 1B). 276 students (92%) measured the meconium content of the sample B accurately, while the remaining 24 students (8%) did not. Repeated performances showed similar results. Taken together, a high percentage of students (at least 70%) without any clinical experience could measure the meconium content of MSAF samples accurately. Students could discriminate the higher concentrations of the meconium better than the lower concentrations of the meconium.

DISCUSSION

There have been no objective methods, which clinicians can easily use in a routine practice, for the measurement of the meconium content in AF until now. Thus, the determination of the meconium content in AF has depended on the clinicians' subjective assessment. By this subjective assessment, the meconium content in AF was classified into three categories: thin (light), moderate, and thick (heavy). This assessment is very important to evaluate the risk for several problems that may happen in the perinatal period (1-5). Fortunately, there have been no reports that this subjective assessment by clinicians caused any serious problems. We think, however, that this subjective assessment should be replaced with a new scientific objective method, which can evaluate the perinatal risk in the form of digitalized results. In line with this, some researchers have tried to develop the new methods for the objective measurement of the meconium content in AF (6-9). Among those, two methods are regarded as simple and reliable: spectrophotometric method and

meconium-crit method (8, 9). The merits of these methods are that they can produce objective results in the laboratory. There has been, however, no report that they were clinically used to measure the meconium content in AF, which indicates that they are not suitable for the use in the routine practice. Both spectrophotometric and meconium-crit methods require expert technicians and instruments such as spectrophotometer and centrifuge. Because of these limitations, neither of two methods have been used by clinicians. Our newly developed method, "Mecometer", is believed to overcome the limitations of the spectrophotometric and meconium-crit methods. The mecometer does not require any expert technicians or any instruments.

In conclusion, the mecometer is a very simple and reliable method for the objective assessment of the meconium content in AF, and as a portable method not requiring any instruments, clinicians will be able to use this mecometer easily. Furthermore, by using the mecometer, more objective assessment of the risk for relevant diseases will be possible.

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