

Gallbladder Motility Change in Late Pregnancy and after Delivery

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Objectives: *The incidence of gallstone disease has increased recently in Korea and there seems to be an increased prevalence of gallstones when in association with pregnancy. Although the pathogenesis is incompletely defined, an altered motility of the gallbladder may contribute to the increased risk of gallstones during pregnancy.*

Methods: *We measured gallbladder volume using real-time ultrasonography to find out the mechanism for the changes of gallbladder motility during late pregnancy. Eighteen pregnant women took the gallbladder ultrasonography during their last trimester of pregnancy and after delivery; gallbladder volume and ejection fraction were calculated in each patient.*

Results: *Fasting gallbladder volumes increased significantly in the last trimester of pregnancy (25.28 ± 14.26 ml) compared with postpartum (17.44 ± 5.82 ml) ($p < 0.05$). Gallbladder volumes measured after fatty meals showed more increment in pregnant women (10.13 ± 7.19 ml) than in those after delivery (4.34 ± 3.36 ml) ($p < 0.005$). A significantly reduced gallbladder ejection fraction was found in the pregnant group ($60.56 \pm 18.80\%$) compared with those after delivery ($77.48 \pm 13.37\%$) ($p < 0.005$).*

Conclusion: *Gallbladder motility in late pregnancy shows significant impairment compared with that in postpartum. Thus, we suggest that gallbladder hypomotility may occur during late pregnancy, and this impairment of gallbladder motility may play an important role in gallstone formation.*

Key Words: *Gallstone, Pregnancy, Gallbladder motility*

INTRODUCTION

Cholesterol cholelithiasis has been reported to be twofold to threefold more common among women than men¹. This difference between men and women begins during puberty and is present throughout the childbearing age². The increased incidence of cholelithiasis is believed to be related to pregnancy^{3,4}. The cause of gallstone formation in pregnant women has been explained by these

two mechanisms: supersaturation of cholesterol in bile and gallbladder hypomotility during pregnancy^{5,6}. Studies of gallbladder motility in pregnant women have been limited due to the radiation hazard and invasiveness of the radiologic procedure. At present, the real-time ultrasonography can provide the measurements of gallbladder volume and ejection fraction easily and safely^{7,8}.

With such backgrounds, we have evaluated the motor functions of the gallbladder in eighteen women during their third trimester of pregnancy and after delivery, and we tried to show that pregnancy itself can alter the gallbladder motility. In addition, we reviewed the effects of the reduced gallbladder motility during pregnancy on the for-

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mation of gallstones.

MATERIALS AND METHODS

1. Materials

Eighteen pregnant women in their third trimester of pregnancy (10 primipara, 8 multipara) were selected for ultrasonographic evaluation. They varied in age from 25 to 37 (mean=29.33±3.11). None of the subjects had a history of gastrointestinal, gallbladder, liver or endocrine disease.

2. Methods

Ultrasonography was performed during the third trimester of pregnancy and between 30 to 60 days after delivery. Measurement of gallbladder volume was performed by one sonographer using a 3.5 MHz convex probe. The real-time ultrasonography was conducted 5 times with an interval of 5 minutes, after overnight fasting, to obtain the average volume of the gallbladder, and it was again conducted 5 times with an interval of 5

minutes, 30 minutes after fatty meals which were blended with were boiled rice, egg, beef and contained 750kcal with 32% of fat.

The volume of the gallbladder was calculated by obtaining the width/height/length with the real-time ultrasonography and multiplying the dimensions using the ellipsoid method⁹⁾(Fig. 1). These fasting and postprandial volumes of the gallbladder were substituted into the formula to calculate the ejection fraction (EF) of the gallbladder¹⁰⁾(Fig. 2).

Results are expressed as mean ± S.D. The data were statistically analyzed using Student's t-test with the level of p value at 0.05 or less.

RESULTS

1. Comparison of gallbladder volume between pregnancy and after pregnancy

The average fasting volume of the gallbladder during pregnancy (25.28±14.26ml) was significantly higher than after delivery (17.44±5.82ml) (p<0.05) (Fig.3). The average gallbladder volume after feeding during pregnancy (10.13±7.19ml) was also significantly higher than after delivery (4.34±3.36ml) (p<0.005) (Fig.4).

2. Comparison of gallbladder ejection fraction

The average ejection fraction of the gallbladder was 60.56±18.80% during pregnancy and 77.48±

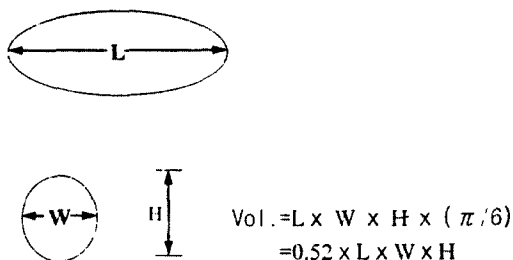


Fig. 1. Ellipsoid method for calculating gallbladder volume from the longitudinal and transverse ultrasound images.

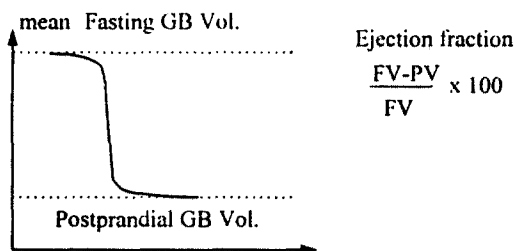


Fig. 2. Equation for calculating ejection fraction of gallbladder in response to a fatty meal.

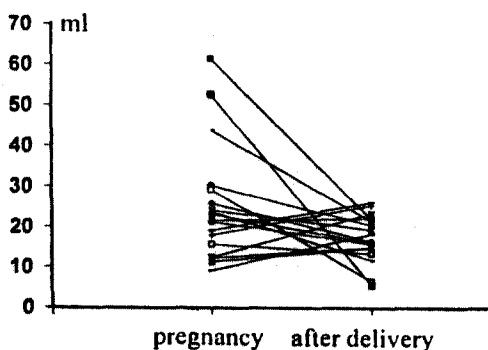


Fig. 3. The changes in fasting gallbladder volume during pregnancy and after delivery. The fasting gallbladder volume significantly decreased after delivery (p<0.05).

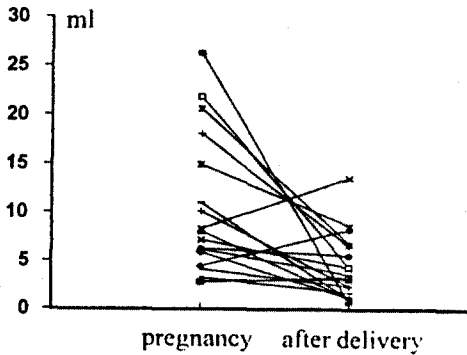


Fig. 4. The changes in postprandial gallbladder volume during pregnancy and after delivery. The difference of gallbladder volume was significant and the changes in gallbladder volume are similar to those of fasting gallbladder volume ($p < 0.005$).

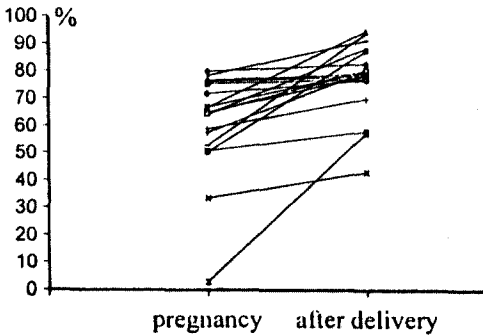


Fig. 5. Ejection fraction changes during pregnancy and after delivery. The ejection fraction of gallbladder significantly increased after delivery ($p < 0.005$).

13.37% after delivery. This finding means significant reduction of ejection fraction during pregnancy ($p < 0.005$) (Fig.5).

3. Biliary sludge

Biliary sludge was found in two women during pregnancy, but the sludge disappeared after delivery. No gallstones were found among the eighteen pregnant women.

DISCUSSION

The common gastrointestinal symptoms during pregnancy are heartburn, indigestion and constipation^{11, 12}. These symptoms were often associated with alterations in both gastrointestinal and biliary motility. It has been well known that gallstone diseases are more common in women than in men¹⁻⁴ and this difference between men and women begins during puberty^{2, 14}. In other words, increased incidence of gallstone disease in women is present throughout their childbearing years and is more remarkable by pregnancy²⁻⁴. Several recent reports also indicated an increased prevalence of gallstones during pregnancy. Valdivieso reported that gallstones were detected in 12.2% of the puerperal women¹⁴ and the high incidence of gallstone during pregnancy does not result in an accumulative prevalence¹⁴. In our study, no subject had gallstones.

The tendency of increasing cholesterol saturation¹⁵ in bile and gallbladder dysmotility during pregnancy are appropriate to the gallstone formation⁶. The cholesterol saturation of gallbladder bile increased during the second and third trimester in a previous study⁶, but the decreased cholesterol saturation, while inhibiting gallbladder emptying¹⁵, showed little correlation between gallbladder dysmotility during pregnancy and cholesterol saturation of bile. Many studies for gallbladder motility revealed increased gallbladder volume and decreased ejection fraction during pregnancy^{6, 7, 16}, while some investigators reported no significant change in ejection fraction during pregnancy¹⁷. The majority of the previous studies were performed with the design of comparing subjects' gallbladder motility with controls'. In this study, we tried to reduce the possible bias of control selection by evaluating gallbladder motility during pregnancy and post delivery in the same subjects.

In Ylöstalo's study, fasting gallbladder volume was 14 ± 0.8 ml in nonpregnant controls, and 31.6 ± 2.0 ml in women in the third trimester of normal pregnancy¹⁸, while the volume was 25.28 ± 14.26 ml in our study, suggesting that gallbladder enlargement and incomplete evacuation of bile from the gallbladder may be one of pathogenetic signifi-

cance during pregnancy.

Increased gallbladder volume during fasting is due to a combination of decreased water absorption by the gallbladder mucosa^{8, 19, 20}, diminished tone of the gallbladder smooth muscle^{7, 21}. It is also partially due to proliferation of the gallbladder wall muscle¹⁶ caused mainly by the high concentration of progesterone⁷. The bile concentrates about 10 times by water absorption from gallbladder mucosa in normal subjects, and the water absorption decreased by estradiol in animal study¹⁸.

The main factor responsible for gallbladder contraction after a meal is cholecystokinin²². A recent study demonstrated that the secretion of cholecystokinin in the response to food intake was enhanced during pregnancy²³, but there was no significant change in the total amount of cholecystokinin. There was no or little correlation between gallbladder volume and cholecystokinin concentration¹⁷ and the gallbladder volume is mainly controlled by smooth muscle relaxation due to elevated serum progesterone level²⁴. Everson et al. demonstrated the linear increase of gallbladder volume correlated directly with serum progesterone in the first two-thirds trimester of pregnancy¹⁶, while Braverman found significantly increased gallbladder volume in second and third trimester but no changes during first trimester⁷. Both of the studies revealed the largest gallbladder volume during the third trimester of pregnancy. For this reason, we selected subjects in their third trimester for measuring gallbladder volume in this study.

In Everson's study, the gallbladder volumes returned toward normal in two weeks postpartum¹⁶. In our study, the gallbladder volume was diminished after delivery (25.28ml→17.44ml fasting, 10.13ml→4.34ml after feeding), and the ejection fraction was increased after delivery (60.56→77.48%).

In some studies, the risk of gallstone is directly related to the number of pregnancies¹³. However, there was no significant difference in gallbladder motility between primipara and multipara in our study. A recent study suggests that the hypomotility of gallbladder in pregnancy induces gallbladder sludge formation. The sludge formation

was thought to be temporarily related to the pregnancy²⁵, because of its tendency to resolve spontaneously postpartum²⁶. In our study, the biliary sludge was observed in two subjects and the sludge disappeared after delivery.

The real time ultrasonogram and the ellipsoid method were used to measure the volume of the gallbladder. While the examinees would inevitably be exposed to radiation or subject to invasive examinations in tests such as cholecystogram or radioisotope scan⁸, the real-time ultrasonography can measure the volume and ejection fraction of gallbladder comparatively easily and precisely without using any complex devices²⁷. In addition, this new test method features outstanding reducibility and therefore, it is thought of as a useful method to estimate the motor function of the gallbladder²⁸. The original method for gallbladder volume using ultrasonography was the sum of cylinders method developed by Everson²⁹, but it was rather time-consuming³⁰. However, Dodds et al. proposed the use of the simple ellipsoid method⁹, and they reported an excellent correlation with the sum of cylinders method³⁰. In the present study, we were able to confirm the good reproducibility of the ellipsoid method comparing the sum of cylinders method.

In summary, gallbladder motility in late pregnancy shows significant impairment compared with that in postpartum. Thus, we suggest that gallbladder hypomotility may occur during late pregnancy and this impairment of gallbladder motility may play an important role in gallstone formation.

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