



Case Report

# A Late Preterm Female Infant with Fetal Growth Retardation in Whom Changes in Autonomic Balance Were Likely Involved in Bradycardia and Residual Urine Retention

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## Abstract

A female infant with Fetal Growth Retardation (FGR), whose fetal echo revealed no particular anatomical abnormalities, showed marked abdominal distension after birth. Abdominal ultrasonography revealed distension to be caused by swelling of the bladder due to residual urine. Her daily micturition volume was within normal range, there was no abnormality in renal function, and no neurological abnormality was observed. Residual urine was prominent for about the first 6 days after birth as her basal heart rate became lower than usual in the early postnatal period. As her basal heart rate then increased again, the volume of residual urine decreased. Newborns with FGR are reported to have a temporary imbalance in the autonomic nerves after birth due to effects of chronic hypoxic stress during the fetal period, and changes in heart rate in these infants are greater than are appropriate for gestational age. The micturition mechanism controlled by the autonomic nerves is also thought to cause residual urine when the predominance between sympathetic nerves and parasympathetic nerves changes temporarily. The patient now relieves herself naturally and is still growing steadily. When searching for the cause of suspected megacystis in the early neonatal period, it is useful to keep in mind transient phenomena such as reported here before proceeding to invasive examinations that may stress the baby.

**Keywords:** Autonomic nervous balance; Bradycardia; Early neonatal period; Fetal growth retardation; Residual urine

## Introduction

The urinary function of newborns is immature compared to that of adults, and newborns can experience so-called “physiological residual urine”. However, newborn babies urinate more frequently than adults, which is thought to compensate for the amount of urine produced [1,2]. We recently reported a male infant with transient isolated congenital megacystis that was identified by fetal echo as a mass lesion in the pelvic cavity and which caused a large amount of residual urine over a limited period of time after

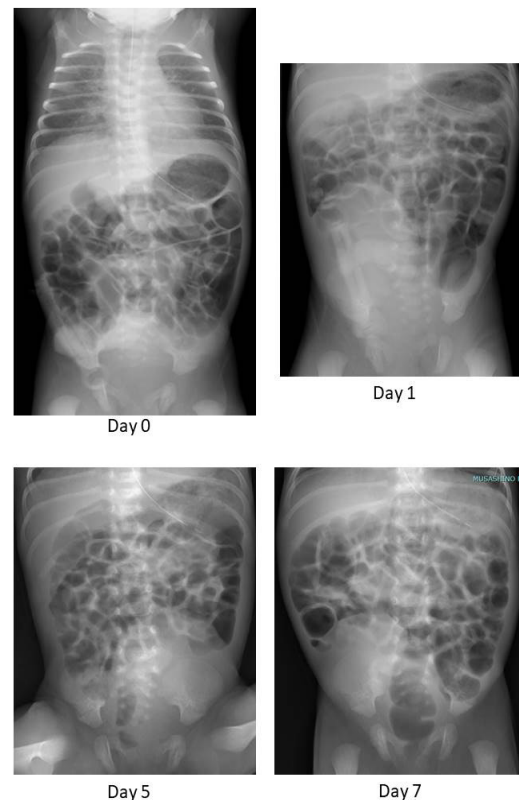
birth [3]. Here, we experienced a late preterm infant with Fetal Growth Retardation (FGR) who had no abdominal abnormalities on fetal echo and megacystis early in life, the cause of which was found to be transient and marked amounts of residual urine. The degree of residual urine in this infant fluctuated in parallel with bradycardic changes in her heart rate, suggesting the involvement of changes in the autonomic nerves caused by placental factors during the fetal period. When fetal echo does not show a mass lesion in the pelvic cavity and residual urine and a huge bladder are found after birth, in a male infant, it is necessary to distinguish the presence of a posterior urethral valve, or other causes, as easy insertion of a urethral catheter can reduce the accuracy of

diagnosis. If the infant is a female, it is valuable to investigate the relationship with heart rate during the diagnostic process as in the present case because it may offer a diagnostic clue that may potentially avoid invasive tests.

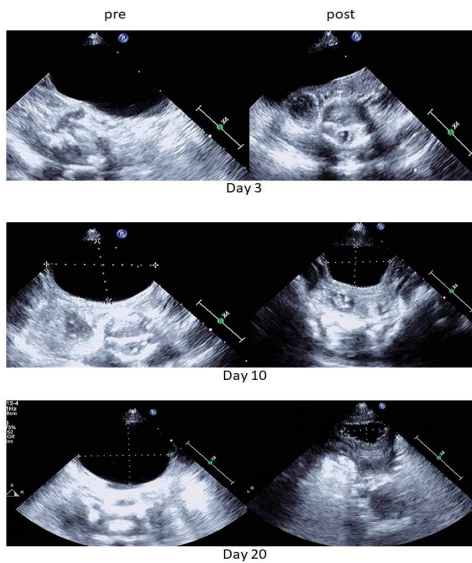
## Case Report

The patient was a female infant with gestational age of 36 weeks and 4 days and birth weight of 1652 g (-2.62 SD). The mother was urgently transported to our hospital to manage FGR observed in the fetus from around 30 weeks of gestation. Fetal echo at admission showed no morphological abnormalities. The mother underwent an emergency cesarean section, and the baby was born with indications of non-reassuring fetal status such as reversal of cord blood flow. Her Apgar score was 8 points at 1 minute and 9 points at 5 minutes, and her respiratory condition immediately after birth was stable. At this time, a considerable amount of colorless and transparent first voided urine was confirmed by inspection. She was admitted to the NICU to manage her as a late preterm birth infant and because her weight was unreasonably light for an infant of this gestational age. General examination and blood test on admission revealed no abnormalities and blood flow of the head, hear, kidneys, and major arteries by ultrasonography was normal. X-ray findings showed uniform distribution of intestinal gas, and gas was also found in the pelvic cavity (Figure 1). As an initial infusion, 10% glucose infusion was started immediately for prevention of hypoglycemia, and the infant's blood glucose level remained stable from the beginning. But the X-ray image at 1 day of age showed an elliptical lesion occupying the lower right quadrant of the abdomen, and abdominal ultrasound confirmed it to be a urine-filled bladder (Figure 1). The infant started enteral nutrition from day 1, but no vomiting or gastric remnants were observed. However, exacerbation of distension mainly in the lower abdomen and skin gloss of the abdominal wall were observed, and she showed no respiratory problems. Abdominal ultrasonography revealed a distended bladder that exceeded the right abdominal umbilicus level from within the pelvic cavity. Echo observations before and after urination confirmed a significant amount of residual urine (Figure 2). No echo abnormalities of the renal pelvis or ureter, intestinal dilatation, or intestinal peristalsis were found. Blood and urine tests revealed no abnormalities in renal function. The amount of urine excreted fluctuated greatly during the day, ranging from 2 to 30 mL/voiding. From around 7 days of age, diurnal variation decreased, and residual urine decreased at the same time. During this time, we focused on the relation between changes in the infant's heart rate and changes in her residual urine output. The infant's heart rate was 170/min immediately after birth, but fell to the 140/min level and stabilized within a few hours thereafter. However, at the age of 1 day, her resting heart

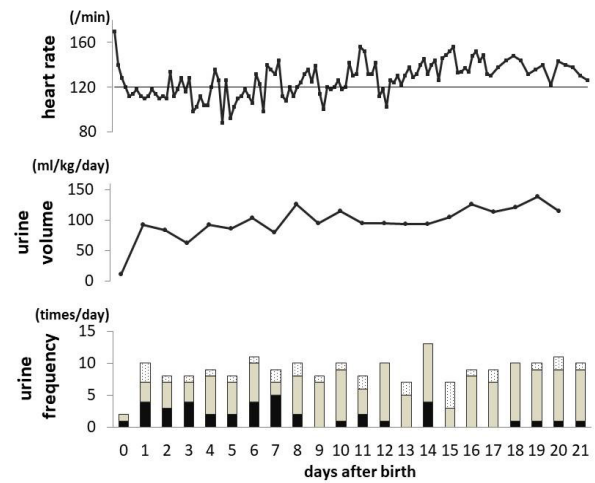
rate showed sinus bradycardia of about 80/min, but no respiratory disorder was observed, and her percutaneous oxygen saturation (SpO<sub>2</sub>) level was maintained at 96% or more under room air. Her blood pressure was also stable. Her heart rate was subsequently noted to increase with a decrease in residual urine volume using the 4 hour voiding observation [2] (Figure 3). After that, there was no drastic decrease in urination volume or relapse of residual urine, and the patient was discharged as an energetic baby at the age of 23 days weighing 1956 g. Presently, she is 3 years old and is growing and developing well. She relieves herself naturally and has shown no abdominal symptoms such as urinary tract infection or constipation. Parent of the infant was informed of this study design, and written informed consent was obtained.



**Figure 1:** Serial changes in abdominal X-ray findings. Two hours after birth, the area of the pelvic cavity where there is no intestinal gas is the shadow of the bladder. At day 1 of age, the bladder extends to the right half of the abdomen, above the umbilicus height. At days 5 of age, the bladder has expanded to the left half of the abdomen, near the height of the umbilicus, as if bowing. At day 7, the dilated bladder is located on the opposite side of day 5.



**Figure 2:** Serial changes in abdominal echography. pre: before urination, post: immediately after urination. At each day, the diaper was opened, an ultrasonic probe was gently applied to the lower abdomen, the probe was moved up and down at the position of the coronal section, and the probe was fixed at the position where the major axis and the minor axis were measured. The same measurement was performed again immediately after urination. At 3 days of age, after 12 g of self-urinating, marked residual urine was still observed. At 10 days of age, the bladder diameter, which was 3.56 cm × 2.29 cm before urination, decreased to 2.16 cm × 1.59 cm after urination. Compared to the age of 3, the amount of residual urine decreased. At day 10, the bladder diameter was 3.37 cm × 2.79 cm before urination and 1.35 cm × 2.09 cm after urination, suggesting that residual urine was further reduced.



**Figure 3:** Serial changes in heart rate, urine volume, and urination frequency using the 4 hour voiding observation. : one-time urination volume is less than 10g, : one-time urination volume is 10g or more and less than 30g, : one-time urination volume is 30g or more. The frequency of urination of which one-time volume less than 10 g was remarkably higher and the frequency of one-time urination volume 10 g or more and less than 30 g was lower compared with that of days 8 or later. This phenomenon coincides with the time when the heart rate from day 1 to day 7 was often slow. At day1 in particular, the frequency of one-time urination volume less than 10 g was high, but that of volume 30 g or more was also high. Thus, this case is different from congenital megacystis in that the infant did not have a large amount of residual urine in every time.

## Discussion

Delayed urination in the early neonatal period involves three

factors: ① low excretion of urine, ② lack of urine flow from the kidney to the bladder, and ③ lack of urine flow from the bladder to the urethra. Thus, it is caused by lack of outflow through either one of these outflow tracts. According to Sherry and Kramer, 7.6% of term infants and 9.5% of preterm infants first micturated by 24 hours after birth, and by 48 hours 99.4% had their first micturition [4,5]. It is normal for newborns to urinate about 20 times a day. Fairhurst et al. reported that the bladder capacity of preterm infants can be easily predicted by body weight (kg)  $\times$  7 (mL) [6]. There are reports from various families regarding physiological residual urine, but the total amount is thought to be about 1-2 mL [2]. One of the characteristics of the present infant was not the congenital giant cystosis revealed by fetal echo, but the distension of the bladder caused by transient residual urine caused by the imbalance between urination and storage after birth. Congenital megacystis is easy to diagnose with fetal screening thanks to the easy availability of ultrasonography. We recently reported a very rare case of transient solitary megacystis [3]. Due to intrauterine growth retardation, the reported infant underwent multiple fetal screening echoes at both the referral hospital and our hospital. As no mass lesions were found in the infant's abdominal cavity, there is no doubt that he had congenital megacystis.

There have been reports of abnormal postnatal urine output using the term "asphyxiated bladder", which describes delayed urination in infants caused by ischemic injury due to asphyxia and in whom renal function is not clear. [7,8] Although urinary production is possible, excretion of urine accumulated in the bladder is poor. The target of hypoxic-ischemic injury is not only brain tissue, but any tissue throughout the body to a greater or lesser extent. Thus, we suggest that abnormalities can occur in the bladder muscles and nervous system that control urinary function, which may lead to dysuria. In boys, it is necessary to distinguish the posterior urethral valve, so caution is required to ensure easy urinary catheterization [7]. According to these reports [7-9], delayed urination is a condition characterized by symptoms similar to urinary retention, such as no urination for 24 to 48 hours after a small initial amount of urination. The present case was characterized by large diurnal variation in the amount of each urination and the amount of residual urine after each urination, which clearly fall outside the category of asphyxiated bladder.

Newborns have physiological residual urine because in the early neonatal period, urination is a reflex action performed without nerve impulses going through the cerebral cortex, and there is lack of coordination between the diuretic muscles and sphincter muscles of the bladder. However, a recent study showed that maturation of the micturition center in the cerebral cortex was complete in term infants aged 37 to 41 weeks and that urination can be performed by commands from the center rather than via spinal reflex during REM sleep [10]. Residual urine is thought to occur because the degree of maturation is not perfect. Maturation is not considered complete at gestational age 33 to 36 weeks. The present patient was born at 36 weeks and 4 days, which is almost 37 weeks,

but this timing falls within the range of premature birth, during which the urination center is still undergoing maturation. Early urination occurs when the bladder filled with urine contracts as the extension stimulus stimulates the pelvic splanchnic nerve, which is a parasympathetic nerve. As shown in the Figure 3, bradycardia tended to be observed in the infant during the first week up to age 7 days when urination of less than 10 mL/void was frequent. This suggests that the bradycardia was predominantly parasympathetic in the infant at this time. Investigations of FGR due to chronic intrauterine hypoxia found that the basal postnatal heart rate was more prone to tachycardia than appropriate for Gestational Age (AGA) and that there was no significant difference between FGR and AGA [11,12]. It has also been noted that bradycardia is related to the degree of FGR and head circumference. Galland et al., who examined the degree of change in heart rate, speculated that immaturity of sympathetic/parasympathetic balance is the cause because the degree of change in heart rate (heart rate variability) is significantly larger than that with FGR [13]. In our case as well, the presence of a period during which the parasympathetic nerve was dominant due to the change in the balance of sympathetic and parasympathetic nerves was likely the cause of the micturition reflex. In addition, when more than 30 mL is urinated, the bladder needs to be filled with urine until just before micturition. This amount far exceeded the permissible bladder volume in the present patient, leading to her glossy abdominal wall. To explain this phenomenon, it seems necessary that bladder extension stimulates the lower abdominal nerve, which is a sympathetic nerve, to relax the bladder. Therefore, a sympathetic predominant state is required during this period. The change in the heart rate of the infant does not mean that bradycardia persisted in the first week after birth. In other words, there appeared to be a period of time during which the parasympathetic nerve was dominant and not that it was constantly dominant, thus suggesting that this phenomenon may be related to the number of urinations in the infant, the amount of a single urination, and the amount of residual urine.

In infants with FGR that cannot be determined by fetal echo screening, when distension of the lower abdomen is noted on postnatal inspection, observation of the transition of micturition frequency and micturition volume and checking bladder capacity before and after micturition by echo may help clarify the condition of the baby. Especially in male infants, a diagnosis of transient residual urine as in the present case would seem to be very useful in the differential diagnosis of genitourinary system disease [7].

## References

1. Der Cruyssen KV, Wachter SD, Hal GV, Win GD, Aggelpoel TV, et al. (2015) The voiding pattern in healthy pre- and term infants and toddlers: a literature review. *Eur J Pediatr* 174: 1129-1142.
2. Sillén U, Hjälmås K (2004) Bladder function in preterm and full-term infants. *Scand J Urol Nephrol Suppl* 215: 63-68.
3. Nakamura T (2017) Isolated congenital megacystis with spontaneous resolution: a case report. *Fukushima J Med Sci* 63: 116-120.

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4. Sherry SN, Kramer I (1957) The time of passage of the first stool and first urine by the newborn infant. *J Pediatr* 46: 158-159.
5. Kramer I, Sherry SN (1957) The time of passage of the first stool and urine by the premature infant. *J Pediatr* 51: 373-376.
6. Fairhurst JJ, Rubin CME, Hyde I, Freeman NV, Williams JD (1991) Bladder capacity in infants. *J Pediatr Surg* 26: 55-57.
7. Robson WJ, Davies RH (1974) Transient retention of urine in the neonatal period. *J Pediatr Surg* 9: 863-866.
8. Ivey HH (1978) The asphyxiated bladder as a cause of delayed micturition in the newborn. *J Urol* 120: 498-499.
9. Soong WJ, Hwang B. (1994) Asphyxiated bladder syndrome in a pediatric intensive care unit. *Acta Paed Sin* 35: 188-196.
10. Fukushima K, Morokuma S, Nakano H (2005) Relationship between eye movement period and micturition in newborn infants differs from that of human fetuses at term. *Croat Med J* 46: 781-785.
11. Spassov L, Curzi-Dascalova L, Clairambault J, Kauffmann F, Eiselt M, et al. (1994) Heart rate and heart rate variability during sleep in small-for-gestational age newborns. *Pediatr Res* 35: 500-505.
12. Ishii H, Takami T, Fujioka T (2014) Comparison of changes in cerebral and systemic perfusion between appropriate- and small-for-gestational-age infants during the first three days after birth. *Brain & Development* 36: 380-387.
13. Galland BC, Taylor BJ, Bolton DPG, Sayers RM (2006) Heart rate variability and cardiac in small for gestational age infants. *J Appl Physiol* 100: 933-939.