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Small-for-gestational-age newborns need a special fluid therapy strategy

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Aim: To determine the fluid requirement of small-for-gestational-age (SGA) newborns and to compare them with that of appropriate for gestational age (AGA) newborns in the first 5 days of life.

Materials and methods: The present study was conducted from January 2007 to August 2007, including newborns with a gestation age of 32-40 weeks, with respiratory problems, feeding problems, and prematurity, and required intravenous fluid for at least 3 days. Two study groups were established: SGA (group 1) and AGA (group 2) according to the Lubchenco scale. All newborns were cared at an ambient humidity of 40% in an incubator and received intravenous fluid therapy. Daily fluid intake was adjusted with urine output, hydration, and weight gain/loss.

Results: During the study period, 124 newborns were admitted to neonatal wards, and only 48 newborns met the inclusion criteria. Two study groups were formed: group 1, SGA (n = 24) and group 2, AGA (n = 24). The comparison of percentage weight loss differences on day 5 with birth weight was 1.39 ± 3.7% in group 1, and 4.29 ± 4.02% in group 2. The mean percentage of weight loss in group 1 was lower than group 2 (P = 0.014). During 5 days, the mean daily fluid requirements in groups 1 and 2 were measured as 103.18 ± 28.68 cc/kg per day and 129.09 ± 25.8 cc/kg per day. The daily fluid requirement in group 1 was lower compared to group 2 (P = 0.003).

Conclusion: SGA newborns need lower fluid requirements, and experience lower weight loss during the first 5 days of life as compared with AGA counterparts, which suggests that fluid requirement of SGA newborns are different from AGA newborns and the fluid therapy of SGA newborns should be special.

Key words: Small-for-gestational-age, infant, weight loss, fluid therapy, fluid balance

Gestasyonel yaşına göre küçük olan infantlar özel bir sıvı tedavi stratejisine ihtiyaç duymaktadır

Amaç: Hayatın ilk beş gününde SGA yenidoğanların sıvı ihtiyaçlarını belirlemek ve AGA infantlarla karşılaştırmak.

Yöntem ve gereç: Ocak 2007 den Ağustos 2007'e kadar olan dönemde, gestasyon yaşı 32-40 hafta olan, solunum ve beslenme problemleri, prematurite, en az 3 gün intravenöz sıvı ihtiyacı olan yenidoğanların alındığı bir çalışma yapıldı. Lubchenco skalasına göre SGA (grup 1) ve AGA (grup 2) olmak üzere iki çalışma grubu oluşturuldu. Tüm yenidoğanlar ortam nemi % 40 olan küvöz içinde bakıldı ve intravenöz sıvı tedavisi aldı. Günlük sıvı ihtiyacı, idrarmiktarı, hidrasyon, kilo alımı/azalmasına göre düzenlendi.

Bulgular: Çalışma süresi boyunca, 124 yenidoğan yoğun bakıma alındı, sadece 48 yenidoğan katılım kriterlerine uygundu. Grup 1, SGA (n = 24) ve grupII, AGA (n = 24) olmak üzere iki çalışma grubu oluşturuldu. Beşinci gündeki kilo kaybı oranı grup 1 de % 1,39 ± 3,7 ve grup 2'de % 4,29 ± 4,02 idi. Grup 1'in ortalama ağırlık kaybı oranı grup 2'den daha düşük bulundu (P = 0,014). Beş gün boyunca, ortalama günlük sıvı ihtiyaçları grup 1'de 103,18 ± 28,68 cc/kg ve grup 2'de 129,09 ± 25,8 cc/kg olarak ölçüldü. Grup 1 de günlük sıvı ihtiyacının grup 2 ile karşılaştırıldığında daha az olduğu görüldü (P = 0,003).

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Sonuç: AGA denkleri ile karşılaştırıldıklarında SGA yenidoğanlar hayatın ilk 5 günü boyunca daha az sıvıya ihtiyaç duyarlar ve daha az kilo kaybederler. Bu veriler SGA yenidoğanların sıvı ihtiyaçlarının AGA yenidoğanlardan farklı olduğunu ve SGA infantların sıvı tedavilerinin özel olması gerektiğini göstermektedir.

Anahtar sözcükler: Gestasyon yaşına göre küçük, infant, ağırlık kaybı, sıvı tedavisi, sıvı dengesi

Introduction

During the first week of life, there is a physiologic contraction of the extra-cellular fluid (ECF) with negative fluid and sodium balances (1-3). The negative fluid balances allow for the physiologic contraction of ECF, which is associated with weight loss during the early neonatal period (1). This is achieved by fluid intake that is less than the amount of water excreted through the kidney in the form of postnatal diuresis and via insensible water loss (1). Postnatal weight loss, a well known but little studied phenomenon, represents mainly fluid loss (4). Postnatal weight loss is usually of brief duration, with a rapid acceleration within the first week of life (5). Previous studies have shown that small-for-gestational-age (SGA) newborns have a different body composition compared to appropriate-for-gestational-age (AGA) newborns (6-8). Because SGA newborns have less lean body mass and fat when expressed per kilogram body weight, their body water content is higher than their AGA counterparts (9). SGA newborns also have less early postnatal weight loss than AGA newborns (6).

In this study we aimed to determine the fluid requirement of SGA newborns and to compare their fluid requirements with that of AGA newborns in the first 5 days of life.

Material and methods

Patients: We conducted the present study in our hospital from January 2007 to August 2007, including newborns with a gestation age of 32-40 weeks. Newborns who were admitted to neonatal wards within 24-h after birth with respiratory, feeding problems, and prematurity, and required intravenous fluid for at least 3 days were enrolled to the study. Criteria for exclusion were congenital anomalies, chromosomal abnormalities or intrauterine and postnatal infection. Two study groups were established: SGA and AGA. Newborns were assessed using the Lubchenco scale, according to weight, height, and head circumference; and newborns whose measurements were found under the 10th percentile considered as SGA (group 1) and those with measurements between the 10th-90th percentile as AGA (group 2) (10). The gestational age was calculated from the mother's last menstrual period in both groups and confirmed by fetal ultrasound and clinical evaluation at birth. Ponderal index was calculated for each SGA infants. Afterwards, SGA infants were divided into 2 groups related to ponderal index: asymmetric SGA infants (<%50 of ponderal index) and symmetric SGA infants (>50% of ponderal index)(11).

All newborns were cared and followed at an ambient humidity of 40% in an incubator (Isolette, Air-Shields, USA) and with the temperature set according to AGA setting. After their admission to the neonatal unit, all newborns received intravenous infusion of a 60-80 mL/kg 10% glucose solution, which was started as AGA and birth weight (12). Fluid management of the first day of therapy is shown in Figure 1. Then, daily fluid intake was increased by 10-20 mL/kg per day, as determined by the amount of

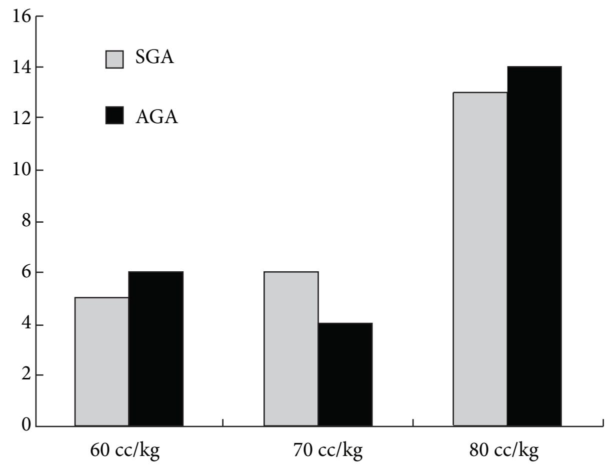

Figure 1. Patients' distribution according to fluid requirement on day 1.

urine output, the status of hydration, and the amount of weight gain or weight loss, from admission until oral feeding reached an adequate volume. Intravenous fluid therapy was arranged to allow 5%-10% body weight loss for term babies and 10%-15% for preterm babies through the end of the 1st week. On the second day of life, 3 mEq/kg per day sodium and 1-2 mEq potassium were initiated. Total parenteral nutrition was started on the second day. Fluid balance was monitored by neonatal staff for 5 consecutive days. Newborns' birth and daily body weight were obtained per routine practice using standard electronic scales. The weight on admission, fluid requirement on the days 1, 3, and 5, daily weight, percentage of weight loss/gain on the days 3 and 5, and daily urine output and density were recorded.

Statistical analysis

Data were analyzed by SPSS (SPSS Inc, v13.0, USA). All measured variables were expressed as mean ± standard deviation. The significance of differences between the means of the 2 groups was determined by the Student's t-test. $P < 0.05$ was considered significant.

Results

During the study period, 124 newborns admitted to neonatal wards. Seventy-four newborns met the inclusion criteria. Twenty-six newborns were excluded because they had infection during NICU admission, or severe respiratory problems, or oral feeding before the 3rd day of admission. Frothy-eight newborns were enrolled in this study. A total of 48 newborns who completed the study were classified into 2 groups: Group 1, SGA (n = 24) and Group 2, AGA (n = 24). Group 1 was composed of 11 female (45%) and 13 male (55%) newborns. Group 2 was consisted of 7 (29%) female and 17 male (71%) newborns. There were no significant differences between 2 groups in terms of gender distribution (P = 0.242). The mean gestation age and birth weight in Group 1 were 35.8 ± 2.04 weeks (median 36 weeks) and 1758.75 ± 39.97 g (median 1750 g), respectively. The mean gestation age and birth weight in Group 2 were 35.3 ± 2.05 weeks (median 36 weeks) and 2385.8 ± 654.2 g (median 2330 g), respectively. There were significant differences between 2 groups in terms of weight distribution (P = 0.001); however, there were no significant differences among the 2 groups with regard to age (P = 0.989). Characteristics of the study population and comparison of SGA and AGA newborns are shown in the Table.

The percentage of weight loss differences on day 5 on the base of birth weight were 1.39 ± 3.7% in group 1, and 4.29 ± 4.02% in group 2, respectively. We found that the mean percentage of weight loss in group 1 was lower compared to group 2 (P = 0.014). During 5 days, the mean daily fluid requirements in group 1 and group 2 were measured as 103.18 ± 28.68 cc/kg per day and 129.09 ± 25.8 cc/kg per day, respectively. Fluid management on day 5 of therapy is shown in Figure 2. Furthermore, we found that the daily fluid requirement in group 1 was lower compared to the other group (P = 0.003). There was no significant differences in mean urine output between the 2 groups (group 1 3.1 ± 1.2 cc/kg per hour, group 2 3.2 ± 0.9 cc/kg per hour, respectively) (P = 0.745).

Table. Characteristics of the study population and comparison of SGA and AGA newborns.

	SGA (mean ± SD) (n = 24)	AGA (mean ± SD) (n = 24)	P
Gender			
Male	13 (55%)	17 (71%)	0.242
Female	11 (45%)	7 (29%)	
Gestation age (week)	35.8 ± 2.0	35.3 ± 2.1	0.99
Birth weight (g)	1759 ± 40	2386 ± 654	0.001
Weight loss differences (%)	1.4 ± 3.7	4.3 ± 4.0	0.01
Fluid requirements (mL/kg per day)	103 ± 28	129 ± 26	0.03
Urine output (mL/kg per hour)	3.1 ± 1.2	3.2 ± 0.9	0.75

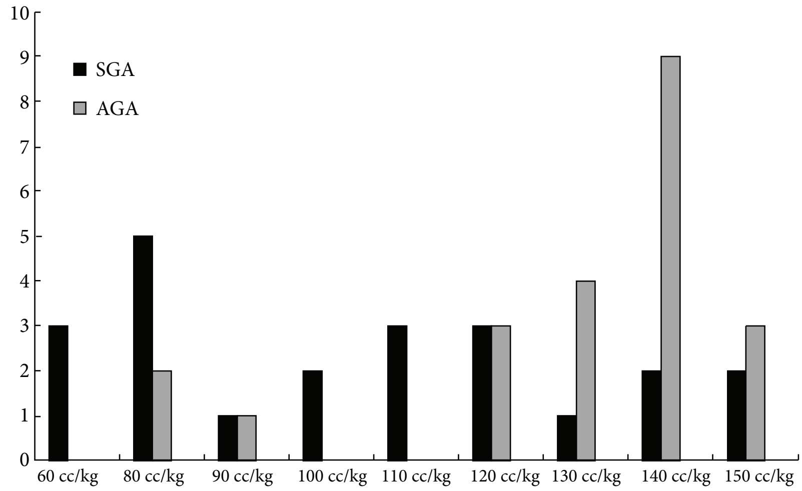

Figure 2. Patients' distribution according to fluid requirement on day 5.

Asymmetric SGA group was composed of 17 neonates, and symmetric SGA group was consisted of 7 neonates. Asymmetric and symmetric neonates' percentage of weight loss on day 5 were 1.14 ± 3.49% and 2.00 ± 4.47%, respectively, and no significant differences were found between 2 groups in terms of percentage of weight loss (P = 0.62). Asymmetric and symmetric neonates' fluid requirements on day 5 were 107 ± 26 mL/kg per day and 94 ± 34 ml/kg per day, respectively, with no significant differences (P = 0.33).

Discussion

In this prospective study, we showed that SGA newborns had a lower fluid requirements and lower weight loss during the first 5 days of life as compared with AGA counterparts who were at the same gestational age. Several studies have shown higher total body fluid content in the SGA newborns compared with their AGA counterparts (6-8).This is due to lower lean body mass and fat content when expressed as percent birth weight (9). Hartnoll et al. showed that the body composition of SGA newborns differs significantly from that of the AGA newborns of the same gestational age, with differences in total body water and both an absolute and relative reduction in body solid mass (7). They also showed that there was no difference in extracellular and intracellular fluid volumes in SGA and AGA preterm newborns and there was no longer a significant difference in total body water per unit lean body mass between SGA and AGA groups (7).

In this study, we showed that weight loss in SGA group on day 5 was lower compared to AGA counterparts. Bauer et al. showed that AGA newborns lost more weight compared to the SGA newborns in immediate postnatal period (6). Wadhavan et al. showed that weight loss in ELBW newborns during the first 10 days was seen less often in SGA newborns compared with AGA newborns (13).

In our study, we evaluated the daily fluid requirement during 5 days in both groups and we found that SGA newborns had a lower fluid requirement compared with AGA counterparts. The fluid therapy in the first day of life and following days for SGA newborns admitted to NICU can be difficult due to lack of data. However, our results and previous studies suggest that total fluid intake should be lower in SGA newborns compared to AGA newborns. The fluid therapy in SGA newborns is usually managed according to the fluid therapy strategy of AGA newborns. Therefore, further investigation and guideline about fluid management in SGA newborns appear to be warranted.

Bauer et al. found a significant weight loss in AGA newborns during the first 6 days of life, accompanied by a period of diuresis, reduction in total body water (TBW), and no change in body solids (6). They declared that initial postnatal weight loss in AGA newborns is caused by contraction of body fluids associated with a period of diuresis and because the AGA newborns had a higher urine output during this time (6). However, in our study, the results showed that there was no statistically significant difference between the 2 groups regarding their urine output and change in body solids between days 1 and 5 of life in both SGA and AGA counterparts, which means that weight loss in SGA newborns is not correlated with urine output only.

Insensible water loss (IWL) is an important factor in the thermoregulation and water balance of the newborn infant (14). Sedin et al. found that in full-term SGA newborns trans-epidermal water loss (TEWL) was significantly lower compared to full-term AGA newborns (15). Skin maturation gradually and progressively reduces the permeability of the skin (16). In SGA newborns, the skin is more mature compared to AGA newborns. Thus trans-epidermal water loss was generally lower in SGA newborns compared to AGA newborns during the first week of post-natal life, irrespective of gestational age at birth (17). IWL was not evaluated in our patients, but we assume that, because of no differences in urine output between the 2 groups, weight loss cannot be attributed to diuresis. On the other hand, the environment was similar both in study and control groups, so it is considered that weight loss contributes to IWL differences between the 2 groups.

It was suggested that SGA newborns' postnatal weight loss was owing to catabolism rather than fluid loss (8), in part due to their higher metabolic rate (18,19). J-C Picaud et al. showed that metabolizable energy utilization was similar in AGA and SGA newborns (20), and urinary volume and sodium excretion were similar in both groups (20). Bauer et al. showed that there were no differences in day to day fluid and gross energy intake during the first week of life in the AGA and SGA groups (6). In our study, calorie intake could not be standardized due to medical requirements, and the day of feeding was different for each group. However, in this study we have aimed to determine the differences with regarding the fluid requirement of SGA and AGA newborns. Therefore, calorie intake was not evaluated for each individual.

In conclusion, SGA newborns had a lower fluid requirements and lower weight loss during the first 5 days of life as compared with AGA counterparts that were at the same gestational age. For this reason, fluid requirement of SGA newborns in the first days of life is different from fluid requirements of AGA newborns. Clearly, more randomized controlled studies are needed to assess fluid therapy in the first days of life of SGA newborns.

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