# Effect of Right-Lateral Versus Left-Lateral Tilt Position on Compression of the Inferior Vena Cava in Pregnant Women Determined by Magnetic Resonance Imaging

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**BACKGROUND:** Despite the existing dogma that women undergoing cesarean delivery under spinal anesthesia should be positioned with a 15° left-lateral tilt, the patients were actually positioned in a right-lateral tilt position in several of the original studies. The superiority of right versus left positioning for optimal inferior vena cava volume is unknown. We used magnetic resonance imaging to compare the effects of right-lateral and left-lateral tilt positions on abdominal aortic and inferior vena cava volumes in pregnant women.

**METHODS:** Thirteen women with singleton pregnancies and gestational age 31–39 weeks underwent magnetic resonance imaging while in the supine position, and in the left-lateral (15° and 30°) and right-lateral tilt (15° and 30°) positions, which were maintained by placing a 1.5-m–long piece of polyethylene foam under either side of the body. Abdominal aorta and inferior vena cava volume were measured between the L1–L2 disk and L3–L4 disk levels using magnetic resonance images.

**RESULTS:** Aortic volume did not differ significantly among any of the positions examined. Mean inferior vena cava volume was significantly greater in the 30° left-lateral tilt position than in the 15° right-lateral tilt (10.7 ± 7.5 vs 5.9 ± 5.1 mL; mean difference, 4.8; 95% CI, 1.2–8.5; $P$ = .002) and 30° right-lateral tilt (10.7 ± 7.5 vs 5.9 ± 2.5 mL; mean difference, 4.8; 95% CI, 1.2–8.4; $P$ = .002) positions. Mean inferior vena cava volume in the 15° left-lateral tilt position did not differ significantly from that in the 15° right-lateral tilt (mean difference, 0.4; 95% CI, −3.2 to 4.0; $P$ = 1.000) or 30° right-lateral tilt (mean difference, 0.4; 95% CI, −3.3 to 4.0; $P$ = 1.000) positions. Mean inferior vena cava volume in the supine position only differed significantly from that in the 30° left-lateral tilt position (5.2 ± 3.8 vs 10.7 ± 7.5 mL; mean difference, 5.5; 95% CI, 1.8–9.1; $P$ < .001). The greatest inferior vena cava volume was observed in the 30° left-lateral tilt position in 9 of 13 subjects (70%), and in the 30° right-lateral tilt in 3 subjects (23%).

**CONCLUSIONS:** The 30° left-lateral tilt position most consistently reduced inferior vena cava compression by the gravid uterus compared with the supine position. Mean inferior vena cava volume in pregnant women was not increased at either angle of the right-lateral tilt position compared with the 30° left-lateral tilt position. However, in a subset of patients, the 30° right-lateral tilt position achieved the optimal inferior vena cava volume. Further investigation to understand this variability is warranted. (Anesth Analg 2019;128:1217–22)

## KEY POINTS

- **Question:** Does a right-lateral tilt position effectively reduce inferior vena cava compression in pregnant women?
- **Findings:** Mean inferior vena cava volume in pregnant women did not differ significantly between any of the right-lateral tilt positions compared with the supine position, whereas mean inferior vena cava volume was significantly greater in the 30° left-lateral tilt position.
- **Meaning:** A left-lateral tilt of 30° consistently relieves inferior vena cava compression in pregnant women, but the 30° right-lateral tilt position achieves the optimal inferior vena cava volume in a subset of patients.

The recommended positioning of a mother after spinal anesthesia for cesarean delivery is a 15° tilt achieved by elevating the right hip or tilting the table.[1–5] This dogma of a 15° left-lateral tilt is ubiquitous in obstetric anesthesia practice based on studies from the 1970s,[6–10] especially the influential study by Crawford et al,[7] who reported significant improvement in the fetal clinical and acid–base status when using the "Crawford wedge" to achieve an approximately 15° tilt during cesarean delivery.

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However, recent studies challenge the original rationale and utility of the 15° tilt rule.[11,12] Using magnetic resonance imaging, we directly demonstrated that the inferior vena cava is completely compressed in healthy women with full-term pregnancies in the supine position, and a left tilt of 30°, but not 15°, partially relieves the inferior vena cava compression.[11] More recently, Lee et al[12] demonstrated in a randomized study of healthy women with full-term pregnancies undergoing elective cesarean delivery with spinal anesthesia that the maternal position (15° left-lateral tilt or supine) had no effect on the neonatal acid–base status when blood pressure was aggressively controlled by vasopressors and crystalloid coload.

Detailed examination of studies from the 1970s, including Crawford et al,[7] showing the beneficial effect of a 15° lateral tilt at cesarean delivery surprisingly revealed that most of the subjects in the tilted group were actually tilted to the right for the surgeon's convenience.[7,8] Although a left-lateral tilt is assumed to be anatomically advantageous to relieve inferior vena cava compression, several reports indicate that a right-lateral tilt, and not a left-lateral tilt, improves the maternal hemodynamics associated with supine hypotensive syndrome in some populations.[13–15] Further, Fields et al[16] demonstrated by ultrasound that 25% of third-trimester subjects had the largest inferior vena cava maximal diameter in the right-lateral tilt position compared with the supine and left-lateral tilt positions. However, no studies to date have investigated the effect of a right-lateral tilt on the volume of the abdominal aorta and inferior vena cava in pregnant women. The present study aimed to investigate the effect of a right-tilt angle (0°, 15°, 30°) compared with a left-tilt angle (0°, 15°, 30°) on abdominal aortic and inferior vena cava volumes in pregnant women using magnetic resonance imaging.

## METHODS

### Subjects

Participants were recruited from the Tokyo Women's Medical University Hospital, Tokyo, Japan, from August 2014 to October 2017 after approval by the hospital ethics committee (institutional review board No: 1976). Before enrollment, written informed consent was obtained from 13 healthy pregnant women with an American Society of Anesthesiologists physical status classification score of II and a cephalic singleton pregnancy at gestational age ranging from 31 to 39 weeks. Pregnancy was confirmed by ultrasound and reported date of last menstruation. Women with cardiovascular disease such as hypertension (systolic blood pressure, >140 mmHg), known fetal abnormality, or who were unable to lie in the supine position in the magnetic resonance imaging due to claustrophobia were excluded from the study. The study was conducted in accordance with the Declaration of the Helsinki—Ethical Principles for Medical Research Involving Human Subjects and the Ethical Guidelines for Clinical Research issued by the Ministry of Health, Labour, and Welfare in Japan. This article adheres to the applicable EQUATOR guidelines.

### Magnetic Resonance Imaging Measurements

Magnetic resonance imaging scanning was performed according to the availability of the magnetic resonance imaging facilities at the convenience of the subjects. Magnetic resonance images of the abdomen were acquired to identify the portal hepatic region and spinal level. Axial magnetic resonance images of the abdomen from the portal hepatic region to the middle of the pelvis were then acquired to measure the volume of the abdominal aorta and inferior vena cava in all 5 positions: supine, 15° and 30° right-lateral tilt positions, and 15° and 30° left-lateral tilt positions. A 1.5-m long, hard, V-shaped, closed-cell polyethylene foam block extending from head to toe was placed under the subject to maintain the subject's body in a consistent right- or left-lateral tilt position. Although the angle was not measured, each subject's body position was visually confirmed. All subjects were positioned supine, then in the left-lateral tilt at 15°, left-lateral tilt at 30°, right-lateral tilt at 15°, and right-lateral tilt at 30° in consecutive order for ease of both the subject and investigator. To target the aorta and inferior vena cava, magnetic resonance images were obtained at 2.3-mm increments using a 1.5-T Magnetom Symphony Magnetic Resonance Imaging (Siemens, Tokyo, Japan) with a fast-spin echo sequence, 1500-millisecond repetition time, 146-millisecond echo time, 40 × 34 cm field of view, 320 × 320 image matrix, and acquisition of 1.5-mm slices at 0.8-mm intervals. The amount of time required to acquire the sagittal and axial magnetic resonance images in each position was 45 seconds, and 6 minutes 36 seconds, respectively.

The images were encoded and randomized to blind the investigator to the source of the image. This was done by rotating the images to achieve a common orientation. Because magnetic resonance imaging slices with subjects in different positions were not necessarily at the same level, the disk levels were used as a reference for anatomic segmentation. The areas of the aorta and inferior vena cava were calculated from the L1–L2 disk level to the L3–L4 disk level in each axial magnetic resonance image by one of the authors (S.S.) using Osirix Imaging Software 5.8.5 (developed by Pixmeo, Bermex, Switzerland). To calculate the aortic and inferior vena cava volumes from the L1–L2 to L3–L4 levels, the area of each structure in each axial section was multiplied by 2.3 mm (the interval between slices). The inferior vena cava could not be detected between the portal hepatic region to the L1–L2 level in the present study due to the limited resolution of the magnetic resonance imaging and the structures adjacent to the inferior vena cava. It was also difficult to detect the inferior vena cava at the L1–L2 disk level. Below the L3–L4 level, the aorta and inferior vena cava branch to the external and internal iliac arteries and veins, respectively.

### Statistical Analysis

A paired $t$ test–based power analysis for calculating sample size ($\alpha = .05$; $\beta = .15$) indicated that ≥13 subjects were required to reveal a mean of 5.0 mL of inferior vena cava volume difference as significant, assuming that the population SD is 4.75 mL (obtained from a previous study[11]). Inferior vena cava volume measurements were obtained from each of the 13 subjects in different tilt positions. To adjust the correlation between inferior vena cava volume measurements obtained from the same subject, a linear model with random block effects was used to estimate the effect of tilt position on inferior vena cava volume, where subjects are considered random blocks. Pair-wise tilt positions were compared using estimated mean inferior vena cava volume and corresponding standard errors obtained from the fitted linear model, and both unadjusted and adjusted (using Bonferroni method) $P$ values and corresponding CIs were obtained. Statistical analyses were performed using the lme4 package of statistical software R version 3.5.0 (R Core Team, Vienna, Austria).

## RESULTS

The characteristics of the 13 study participants are presented in Table 1. The abdominal aorta was easily identified by its round shape, and the mean volume did not differ significantly in any of the positions examined (Table 1; Figure).

**Table 1. Patient Characteristics (n = 13) and Mean Volume of Aorta and Inferior Vena Cava (mL)**

| | | |
|---|---|---|
| Age (y) | 35 ± 4 | |
| Height (cm) | 157 ± 4 | |
| Weight (kg) | 64 ± 10 | |
| Body mass index | 26 ± 4 | |
| Gestational age (wk) | 37 (31–39) | |
| Parity (0/1/2/3) | 8/4/0/1 | |
| Position | Inferior Vena Cava | Abdominal Aorta |
| Supine | 5.2 ± 3.8 | 14.3 ± 1.9 |
| 15° left-lateral tilt | 6.3 ± 4.8 | 14.4 ± 1.7 |
| 30° left-lateral tilt | 10.7 ± 7.5 | 15.2 ± 2.4 |
| 15° right-lateral tilt | 5.9 ± 5.1 | 14.9 ± 2.1 |
| 30° right-lateral tilt | 5.9 ± 2.5 | 15.1 ± 2.2 |

Values are mean ± SD, median (range), or number of women.

With subjects in the supine position, the inferior vena cava was almost completely compressed by the gravid uterus in all subjects except one (No. 7) (Tables 1–2; Figure). Compared with the supine position, inferior vena cava volume varied between subjects in each of the lateral tilt positions. Inferior vena cava volume in the 15° left-lateral tilt position was increased in 8 of 13 subjects (62%) and decreased in 5 of 13 subjects (38%), whereas inferior vena cava volume in the 30° left-lateral tilt position was increased in 12 of 13 subjects (92%) (Table 2). Inferior vena cava volume in subjects in the 15° right-lateral tilt position was increased in 6 of 13 subjects (46%) and decreased in 7 of 13 subjects (54%), and inferior vena cava volume in the 30° right-lateral tilt was increased in 8 of 13 subjects (62%) and decreased in 4 of 13 subjects (30%) (Table 2).

The greatest inferior vena cava volume was observed in the 30° left-lateral tilt position in 9 of 13 subjects (70%), in the 30° right-lateral tilt in 3 subjects (23%), and in the 15° left-lateral tilt in 1 subject (8%). The greatest inferior vena cava volume was not observed in the supine or 15° right-lateral tilt positions in any of the subjects (0%) (Table 2).

Mean inferior vena cava volume in the 30° left-lateral tilt position significantly differed from that in the 15° right-lateral tilt (mean difference, 4.8; 95% CI, 1.2–8.5; $P$ = .002) and

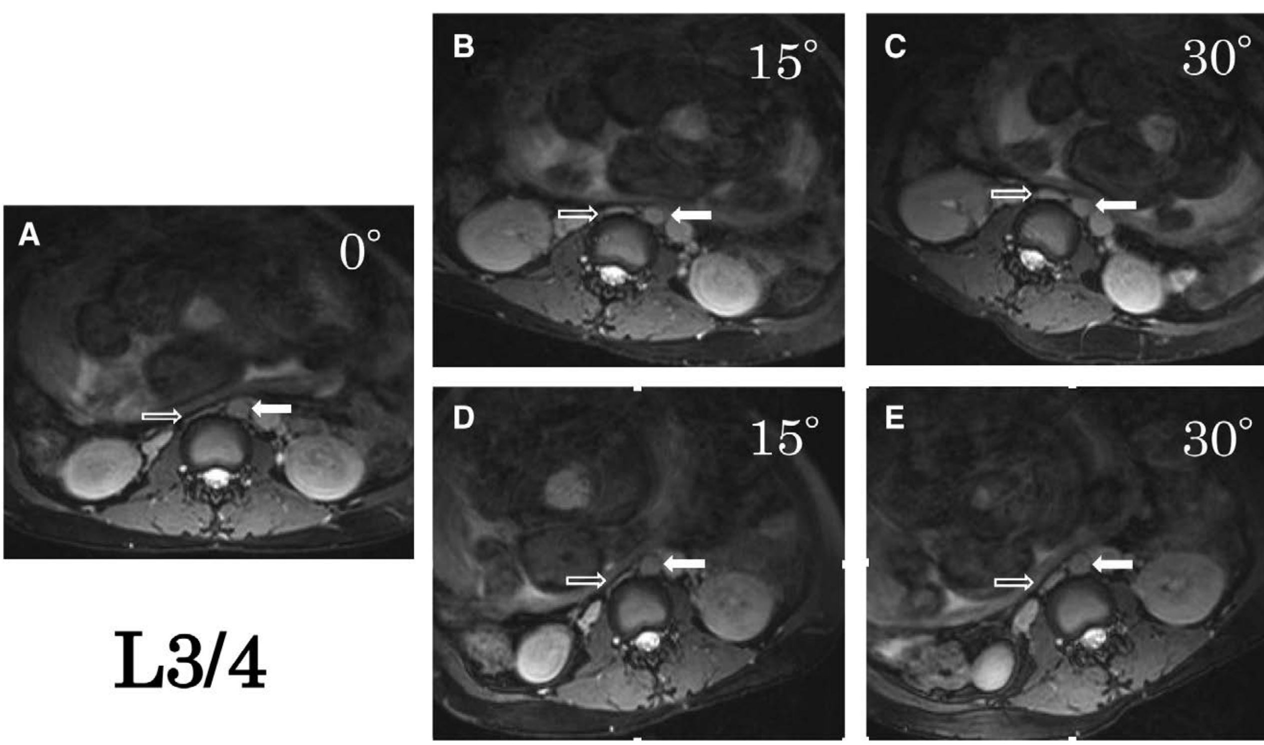


**Figure.** Magnetic resonance images of a 41-y-old pregnant woman (the fetus was in the left occiput position; patient No. 2) in the supine position (A), left-lateral tilt positions at 15° (B) and 30° (C), and right-lateral tilt positions at 15° (D) and 30° (E) at the L3–L4 disk level. A–E, Aortic size (solid arrow) did not change significantly in any position. The inferior vena cava (outlined arrow) was almost completely compressed, and the shape appeared band-like in the supine position. In the 15° left-lateral tilt position, the fetus was moved to the left, slightly reducing inferior vena cava compression. Inferior vena cava compression was reduced in the 30° left-lateral tilt position. In the 15° right-lateral tilt position, the fetus was moved to the right, and inferior vena cava compression remained in the band-like shape. In the 30° right-lateral tilt position, inferior vena cava compression was reduced. The inferior vena cava area at each level was 0.4, 0.6, 1.1, 0.4, and 1.1 $cm^2$, respectively. A–E, In these axial images, anterior is at the top of the figure, and anatomic right is to the left in the figure.

**Table 2. Individual Parturient Characteristics and Changes in the Inferior Vena Cava Volume in Pregnant Women**

| | | | | | | | Inferior Vena Cava Volume (mL) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Left Tilt | | Right Tilt | |
| No. | Gestational Age (wk) | Age (y) | Body Mass Index | Side of Fetal Spine | Estimated Fetal Weight (g) | Parity | 0° | 15° | 30° | 15° | 30° |
| 1 | 31 | 30 | 23.4 | Left | 1658 | 1 | 2.3 | 3.0 | 3.4 | 1.0 | 2.0 |
| 2 | 36 | 41 | 23.9 | Left | 2750 | 1 | 4.5 | 4.1 | 7.3 | 5.5 | 6.0 |
| 3 | 38 | 38 | 29.9 | Right | 2824 | 1 | 3.0 | 2.8 | 4.3 | 5.9 | 6.0 |
| 4 | 39 | 31 | 23.5 | Right | 3157 | 0 | 4.0 | 10.3 | 20.1 | 8.7 | 7.0 |
| 5 | 38 | 29 | 37.5 | Right | 3421 | 0 | 2.9 | 3.5 | 24.0 | 3.6 | 7.8 |
| 6 | 39 | 38 | 21.4 | Left | 2754 | 0 | 2.9 | 2.6 | 3.9 | 3.9 | 4.7 |
| 7 | 37 | 34 | 29.7 | Right | 3118 | 0 | 16.6 | 18.8 | 24.4 | 21.8 | 9.0 |
| 8 | 38 | 34 | 24.5 | Left | 2704 | 0 | 4.6 | 4.2 | 5.7 | 3.8 | 6.1 |
| 9 | 37 | 37 | 22.0 | Right | 2900 | 3 | 4.6 | 4.8 | 10.5 | 3.5 | 3.4 |
| 10 | 37 | 34 | 24.3 | Right | 3050 | 1 | 9.1 | 13.0 | 7.7 | 6.8 | 11.3 |
| 11 | 34 | 38 | 25.6 | Left | 2180 | 0 | 3.1 | 4.0 | 13.5 | 3.0 | 3.1 |
| 12 | 36 | 31 | 23.5 | Right | 2500 | 0 | 5.0 | 4.6 | 6.7 | 4.5 | 4.5 |
| 13 | 35 | 34 | 25.3 | Right | 2600 | 0 | 5.6 | 5.8 | 7.6 | 4.4 | 5.9 |

**Table 3. Pairwise Comparison of Tilt Positions in Terms of Mean Inferior Vena Cava Volume Using the Fit of Linear Mixed-Effects Model**

| | | | Unadjusted 95% CI | | | Adjusted 95% CI | |
|---|---|---|---|---|---|---|---|
| Position | Estimate | Unadjusted *P* Value | Lower | Upper | Adjusted *P* Value | Lower | Upper |
| 0° vs left-15° | 1.0 | .434 | −1.5 | 3.6 | 1.000 | −2.6 | 4.7 |
| 0° vs left-30° | 5.5 | <.001 | 2.9 | 8.0 | <.001 | 1.8 | 9.1 |
| 0° vs right-15° | 0.6 | .630 | −1.9 | 3.2 | 1.000 | −3.0 | 4.3 |
| 0° vs right-30° | 0.7 | .613 | −1.9 | 3.2 | 1.000 | −3.0 | 4.3 |
| Left-30° vs right-15° | 4.8 | <.001 | 2.3 | 7.4 | .002 | 1.2 | 8.5 |
| Left-30° vs right-30° | 4.8 | <.001 | 2.2 | 7.4 | .002 | 1.2 | 8.4 |
| Left-30° vs left-15° | 4.4 | .001 | 1.9 | 7.0 | .007 | 0.8 | 8.1 |
| Left-15° vs right-15° | 0.4 | .764 | −2.2 | 3.0 | 1.000 | −3.2 | 4.0 |
| Left-15° vs right-30° | 0.4 | .782 | −2.2 | 3.0 | 1.000 | −3.3 | 4.0 |
| Right-15° vs right-30° | 0.0 | .981 | −2.6 | 3.0 | 1.000 | −3.7 | 3.6 |

Table 3 shows both unadjusted and adjusted (using Bonferroni method) *P* values, and corresponding CIs for all pairwise comparisons involving the tilt positions 0°, left-30°, and left-15° are considered. Mean inferior vena cava volume of the tilt position left-30° was significantly different from that in all other tilt positions, after adjusting for multiple comparisons using Bonferroni method.

30° right-lateral tilt (mean difference, 4.8; 95% CI, 1.2–8.4; *P* = .002) positions (Table 3). Mean inferior vena cava volume in the 15° left-lateral tilt position did not differ significantly from that in the 15° right-lateral tilt (mean difference, 0.4; 95% CI, −3.2 to 4.0; *P* = 1.000) or 30° right-lateral tilt positions (mean difference, 0.4; 95% CI, −3.3 to 4.0; *P* = 1.000; Table 3). Mean inferior vena cava volume in the supine position did not differ significantly from that in the other positions, except for the 30° left-lateral tilt position (mean difference, 5.5; 95% CI, 1.8–9.1; *P* < .001; Table 3).

## DISCUSSION

Mean inferior vena cava volume in 13 women with singleton pregnancies (gestational age, 31–39 weeks) was significantly lower in subjects positioned in the 15° and 30° right-lateral tilt positions compared with the 30° left-lateral tilt position. Mean inferior vena cava volume in both right-lateral tilt positions did not differ significantly from that in the supine position, whereas it was significantly greater in the 30° left-lateral tilt position than in the supine position. Mean inferior vena cava volume in the 15° left-lateral tilt position did not differ significantly from that in the 15° and 30° right-lateral tilt positions. In contrast, aortic volume did not differ in any position or angle examined.

These data support the findings of our previous magnetic resonance imaging study of term pregnant women suggesting that the 15° left-lateral tilt position does not consistently reduce inferior vena cava compression by the enlarged gravid uterus.[11] Mean inferior vena cava volumes of the subjects in the supine (0°) position and in the left-lateral tilt position at 15° and 30° were comparable to those obtained in our previous study.[11] Similarly, inferior vena cava compression was consistently relieved by a 30° left-lateral tilt, consistent with our previous study.[11] Furthermore, aortic volume at the L1/2–3/4 disk level did not differ between the supine position and left-lateral tilt positions, consistent with our previous study.[11]

Despite the accepted routine practice of placing pregnant women in the left-lateral tilt position after spinal anesthesia for cesarean delivery,[1–4,6,17,18] very little evidence specifically addresses the advantages of a left-over right-lateral tilt for hemodynamic disturbances and uteroplacental hypoperfusion in pregnant women.[9,10,19] Importantly, the right-lateral tilt position for relieving inferior vena cava compression has never been morphologically validated. In 2016, Saravanakumar et al[20] reported cross-sectional inferior vena cava and aortic areas calculated from magnetic resonance images for 6 term obese pregnant women in various postures, including the right-lateral decubitus position. Similar to our findings, they showed that the mean inferior vena cava cross-sectional area was significantly increased in the left-lateral decubitus position, but not in the right-lateral decubitus position, compared to a supine position with pelvic tilt. However, in contrast to our findings, the mean inferior vena cava cross-sectional area did not differ between the left and right decubitus positions.[20] This discrepancy between the findings of Saravanakumar et al[20] and those of the present study might be due to methodological differences: they compared right and left decubitus positions, whereas we compared 15° and 30° lateral tilt positions. Furthermore, Saravanakumar et al[20] only measured the cross-sectional area of the inferior vena cava at the L2–L3 level in 6 women, while we measured the volumes of the aorta and inferior vena cava from the L1–L2 to L3–L4 levels on several magnetic resonance images (≈140 images/subject) in 13 women.

Another important finding of the present study is the marked between-subject variability in the inferior vena cava volume depending on the position. Compared with the other positions, inferior vena cava volume was greatest in the 30° right-lateral tilt position in 23% (3/13) of the subjects. Fields et al[16] ultrasonographically measured intrahepatic inferior vena cava diameter in 26 third-trimester pregnant women in 3 different positions: supine, left-lateral tilt (30°), and right-lateral tilt (30°), and reported that the mean intrahepatic inferior vena cava diameter is significantly greater in subjects positioned with a 30° left-lateral tilt, but not with a right-lateral tilt. They also identified variability in the maximum inferior vena cava diameter between subjects depending on the position: inferior vena cava maximum diameter was largest in the right-lateral tilt position in 28% of subjects and in the supine position in 24% of subjects. Due to difficulties visualizing the distal inferior vena cava by ultrasound in late pregnancy, they measured the proximal portion of the inferior vena cava just below entry of the hepatic veins, which is more proximal than where the gravid uterus mechanically compresses the inferior vena cava.[21] Therefore, their finding reflects the net effect on the proximal intrahepatic inferior vena cava diameter, which is different from the level of the inferior vena cava we measured.

Taken together, although a left-lateral tilt of 30° is ideal for avoiding inferior vena cava compression for the majority of healthy full-term women without neuraxial anesthesia, a 30° right-tilt position is more advantageous for maintaining inferior vena cava volume in some patients. These findings may partly explain the conflicting results regarding the beneficial effect of the right-lateral tilt on maternal hemodynamics and support case reports showing that only the right-lateral tilt position is effective for treating supine hypotensive syndrome in women undergoing cesarean delivery.[13–15] The reason for this variability in the inferior vena cava volume depending on the positions remains unclear. The degree of inferior vena cava compression by the gravid uterus is influenced by many factors (eg, the side of fetal spine).[22,23] In our present study, the number of subjects studied was small, and the statistical power of our study was not sufficient for a multivariate analysis to accurately determine the precise factors resulting in a larger inferior vena cava volume in right-tilted patients. Further studies with large sample sizes are required.

This study has several limitations. First, the enrolled pregnant subjects were healthy nonlaboring women. None had received a regional anesthetic or fluid therapy that leads to abdominal muscle relaxation or redistribution of IV fluid, which limits the external validity of our results for pregnant women in active labor or undergoing cesarean delivery under spinal anesthesia. Second, our subjects were all able to tolerate the supine position during magnetic resonance imaging, which excludes those patients presenting the most concern (ie, patients with supine hypotensive syndrome). Third, the Japanese pregnant subjects in our present study were small (mean body mass index, 26.0) by the standards of many Western countries. The results might differ in obese women. Fourth, we visually confirmed that the subject's body was properly positioned on the foam, but the angle of the body was not directly assessed using a protractor during magnetic resonance imaging. Fifth, measurements of the aortic and inferior vena cava volumes were obtained only from the L1–L2 to the L3–L4 levels due to the low resolution of the magnetic resonance imaging. Higher magnetic resonance imaging resolution is needed to detect distal aorta and inferior vena cava volumes. Finally, gestational age ranged from 31 to 19 weeks. The study would be more powerful if the subjects were all at full term. Because magnetic resonance imaging availability was limited in the present study compared with our previous study, coordination with subject availability for magnetic resonance imaging was difficult and the study period would have to be extended. Therefore, we included subjects in the third trimester but not at full term who could complete the study within a reasonable time-frame (3 years, 1 month), similar to that in our previous study (3 years, 9 months).

In conclusion, we demonstrated that the 30° left-lateral tilt position consistently reduced compression of the inferior vena cava by the gravid uterus compared with the supine position. The mean inferior vena cava volume in pregnant women was not increased in either the 15° or 30° right-lateral tilt positions compared with that in the 30° left-lateral tilt position. However, in a subset of patients, the optimal inferior vena cava volume was achieved in the 30° right-lateral tilt position. Further investigation to understand this variability is warranted.

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