

## UTERINE ARTERY DOPPLER FLOW INDICES IN PREGNANT WOMEN DURING THE 21 WEEKS + 0 DAYS AND 23 WEEKS + 6 DAYS GESTATIONAL AGES: A STUDY OF 59 PATIENTS

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**ABSTRACT.** Uterine artery Doppler flow studies during the 21<sup>st</sup> and 24<sup>th</sup> weeks of pregnancy are important in the prediction of preeclampsia and IUGR in pregnant women and also in the prevention thereof.

Our study of the Doppler flow indices of the uterine arteries involves 59 patients examined in our clinic, with pregnancies ranging from 21 weeks + 0 days to 23 weeks + 6 days.

There were 17 patients from 21 weeks + 0 days to 21 weeks + 6 days (28.82%), 23 from 22 weeks + 0 days to 22 weeks + 6 days (38.98%), and 19 from 23 weeks + 0 days to 23 weeks + 6 days (32.20%). The values of the Doppler indices were: PI  $1.06 \pm 0.40$ ,  $1.00 \pm 0.33$ ,  $1.07 \pm 0.45$ , and  $1.11 \pm 0.38$  and RI  $0.58 \pm 0.11$ ,  $0.57 \pm 0.10$ ,  $0.58 \pm 0.12$ , and  $0.59 \pm 0.10$  for the entire group and for the three intervals respectively. There were 6 (10.17%), 9 (15.25%), and 44 (74.58%) patients with bilateral, unilateral and absent uterine artery notching, respectively. The Doppler indices for the three aforementioned groups were:  $1.58 \pm 0.42$ ,  $1.29 \pm 0.52$ , and  $0.95 \pm 0.28$  for the PI and  $0.72 \pm 0.10$ ,  $0.63 \pm 0.12$ , and  $0.55 \pm 0.09$  for the RI, respectively.

The mean uterine artery PI and RI vary from 21 weeks + 0 days-21 weeks + 6 days to 23 weeks + 0 days-23 weeks + 6 days. They also decrease from pregnant patients with bilateral uterine artery notching to those without notching. Our results are similar to those in literature.

**KEYWORDS:** pregnancy, gestational age, uterine artery notching, Doppler indices, pulsatility index, resistivity index, preeclampsia, IUGR

### INTRODUCTION

Doppler ultrasound, as a non-invasive imaging method for the examination of the uteroplacental circulation, could be used as a screening test for several pregnancy associated diseases and complications, including preeclampsia and IUGR (Campbell et al., 1983). Elevated blood flow resistance indices of the uterine arteries at 20 and 24 weeks of gestation occur more commonly in women who develop pre-eclampsia occur more commonly in women who develop pre-eclampsia, but the association reveals only low positive predictive values (Valensise et al., 1998). Conflicting results published to date perhaps reflect differences in the selected populations, the anatomical sites of measurement, the indices used to describe an abnormal waveform, as well as the outcome measures for prediction (Valensise et al., 1998; Chappell et al., 1998). Doppler indices have been analyzed only in a cross-sectional way without considering the longitudinal fall in resistance that is to be observed in normal pregnancies (Arduini et al., 1994).

Several studies have assessed the uterine artery Doppler flow indices at gestational ages of 21-24 weeks or close to this period:

- 172 women at high risk for hypertensive disorders of pregnancy or intrauterine growth restriction; the impedance to flow in the uterine arteries at 21–24 weeks of gestation was measured, an abnormal result by a resistance index of more than 0.68 being defined (Zimmermann et al., 1997);

- the average resistance index from the left and right uterine and arcuate arteries in 925 pregnancies at 16–24 weeks gestation was calculated; a resistance index above the 95th centile meant a 10-fold increase in risk for a severe adverse outcome, defined by fetal death, placental abruption, intrauterine growth restriction or pre-eclampsia (Bewley et al., 1991);

- a study of 2058 pregnancies at 18–22 weeks revealed a resistance index above the 95th centile or the presence of an early diastolic notch in either of the two uterine arteries in 16% of the pregnancies; this study showed that abnormal Doppler results provide a better prediction of the more severe types of pregnancy complications (Bower et al., 1993);

- an abnormal result (mean resistance index of more than 0.58) was found in 9.6% of patients in a group of 272 primigravidas at 22 weeks of gestation (Valensise et al., 1993);

- the examination of the uterine arteries at 19–24 weeks of gestation in 457 nulliparous women found an increased impedance, meaning a resistance index greater than 0.57 in 11% of cases (North et al., 1994);

-334 patients considered to be at medium risk for the development of pregnancy-induced hypertension, examined at 20 weeks of gestation 10. a mean resistance index above the 90<sup>th</sup> centile and the presence of bilateral diastolic notches, was found in 4.2% of cases (Chan et al., 1995);

-946 unselected women examined at 19–21 weeks of gestation 12; 12.4% had bilateral notches and an odds ratio for developing pre-eclampsia of 12.8, and 52.6 for pre-eclampsia requiring delivery before 37 weeks; normal uterine artery Doppler studies revealed an odds ratio for developing pre-eclampsia of 0.11 and 0.3 for intrauterine growth restriction (birth weight below the 5th centile for gestation), it was 0.3; women with normal uterine artery Doppler studies at 20 weeks constitute a group that have a low risk of developing obstetric complications related to uteroplacental insufficiency, while patients with bilateral notches have an increased risk of the subsequent development of such complications; as a result, Doppler studies of the uterine arteries at the time of the routine 20-week anomaly scan may be of use in determining the type and level of antenatal care that is offered to women (Kurdi et al., 1998);

Frusca et al. - 419 nulliparous women examined at 20 weeks of gestation; those with increased mean resistance index (greater than 0.58) had the uterine arteries reexamined by color Doppler at 24 weeks, with persistently high resistance observed in 8.6% of the patients; in the group with increased resistance at 20 weeks and normal results at 24 weeks, the prevalence of pregnancy complications was not increased compared to those with normal impedance at 20 weeks (Frusca et al., 1997);

-1233 unselected women examined by continuous wave Doppler at 20 weeks of gestation, those with increased impedance (resistance index greater than the 95th centile or early diastolic notch in either of the uterine arteries) being reexamined at 24 weeks; a persistently increased impedance was observed in 8.9% of the patients in this group (Harrington et al., 1996);

-1757 singleton pregnancies attending for routine ultrasound examination at 23 weeks were also examined by uterine artery Doppler, with an increased impedance observed in 7.3% of patients, including 5.1% with mean pulsatility index of above 1.45 and 4.4% with bilateral uterine artery notches; the results of this study suggest that a one-stage color Doppler screening program at 23 weeks identifies most women who subsequently develop the serious complications of impaired placentation associated with delivery before 34 weeks and the screening results are similar if the high-risk group is defined either as those with increased PI or those with bilateral notches (Albaiges et al., 2000);

-2600 unselected women were randomized to Doppler and non-Doppler groups; the Doppler studies were performed at 19–22 weeks and then again at 32 weeks for those classified as being at low risk, and monthly Doppler studies in those considered at high risk.; an abnormal result was defined by the presence of an abnormal waveform bilaterally at the uterine arteries; there was a high frequency of pregnancy complications in women with abnormal uterine artery waveforms and abnormal waveforms were an indicator of subsequent fetal compromise, but no improvement in neonatal outcome was revealed by routine Doppler screening (Davies et al., 1992).

## MATERIALS AND METHODS

We assessed the uterine artery Doppler flow indices in 59 pregnant patients within the 21 weeks + 0 days and 23 weeks + 6 days gestational ages in our clinic by using a Sonoscape SSI-6000 and a General Electric Logiq e ultrasound devices. The Doppler flow was analyzed with a 2 mm window and an insonation angle of less than 30 degrees, according to existing guidelines.

## RESULTS

There were 17 patients from 21 weeks + 0 days to 21 weeks + 6 days (28.82%), 23 from 22 weeks + 0 days to 22 weeks + 6 days (38.98%), and 19 from 23 weeks + 0 days to 23 weeks + 6 days (32.20%) (figure 1). The values of the Doppler indices were: PI  $1.06 \pm 0.40$ ,  $1.00 \pm 0.33$ ,  $1.07 \pm 0.45$ , and  $1.11 \pm 0.38$  and RI  $0.58 \pm 0.11$ ,  $0.57 \pm 0.10$ ,  $0.58 \pm 0.12$ , and  $0.59 \pm 0.10$  for the entire group and for the three intervals respectively. There were 6 (10.17%), 9 (15.25%), and 44 (74.58%) patients with bilateral, unilateral and absent uterine artery notching, respectively (figure 2). The Doppler indices for the three aforementioned groups were:  $1.58 \pm 0.42$ ,  $1.29 \pm 0.52$ , and  $0.95 \pm 0.28$  for the PI and  $0.72 \pm 0.10$ ,  $0.63 \pm 0.12$ , and  $0.55 \pm 0.09$  for the RI, respectively.

Tables 1 and 2 present the mean, standard deviations and the 10<sup>th</sup> and 90<sup>th</sup> percentiles for the pulsatility and resistivity indices, while figures 1 and 2 present the means and the standard deviations thereof. Figure 3 presents the mean PI and RI in the three gestational age groups and figure 4 the mean PI and RI of the patients according to the presence of notching. Figure 5 shows the mean PI and RI among the three gestational age groups.

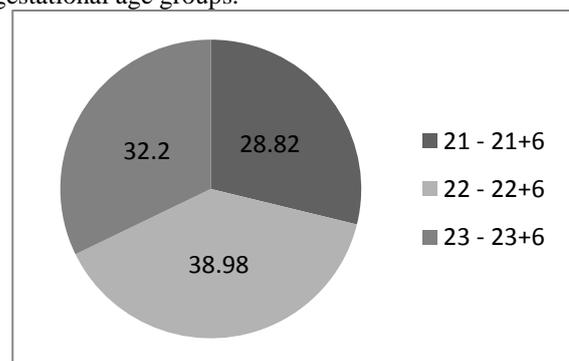


Figure 1. Distribution of age groups

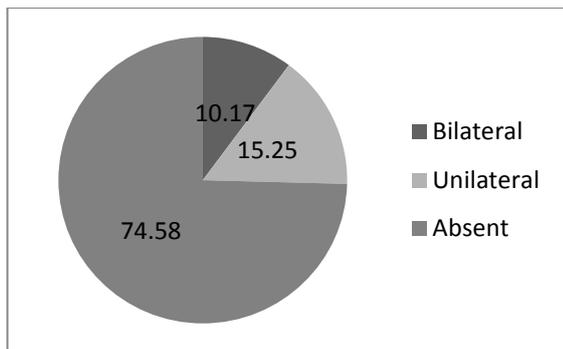


Figure 2. Distribution of uterine artery notching

Table 1. Mean PI±SD, 10<sup>th</sup> and 90<sup>th</sup> percentiles

Group	PI	10 <sup>th</sup>	90 <sup>th</sup>
All (n=59)	1.06±0.40	0.66	1.75
21 weeks + 0 days to 21 weeks + 6 days (n=17)	1.00± 0.33	0.63	1.35
22 weeks + 0 days to 22 weeks + 6 days (n=23)	1.07±0.45	0.69	1.81
23 weeks + 0 days to 23 weeks + 6 days (n=19)	1.11±0.38	0.72	1.61
Bilateral uterine artery notching (n=6)	1.58±0.42	1.04	1.92
Unilateral uterine artery notching (n=9)	1.29±0.52	1.03	1.31
Absent uterine artery notching (n=44)	0.95±0.28	0.71	1.15

Table 2. Mean RI±SD, 10<sup>th</sup> and 90<sup>th</sup> percentiles

Group	RI	10 <sup>th</sup>	90 <sup>th</sup>
All (n=59)	0.58±0.11	0.45	0.75
21 weeks + 0 days to 21 weeks + 6 days (n=17)	0.57±0.10	0.44	0.68
22 weeks + 0 days to 22 weeks + 6 days (n=23)	0.58±0.12	0.46	0.80
23 weeks + 0 days to 23 weeks + 6 days (n=19)	0.59±0.10	0.48	0.71
Bilateral uterine artery notching (n=6)	0.72±0.10	0.58	0.80
Unilateral uterine artery notching (n=9)	0.63±0.12	0.58	0.67
Absent uterine artery notching (n=44)	0.55±0.09	0.48	0.63

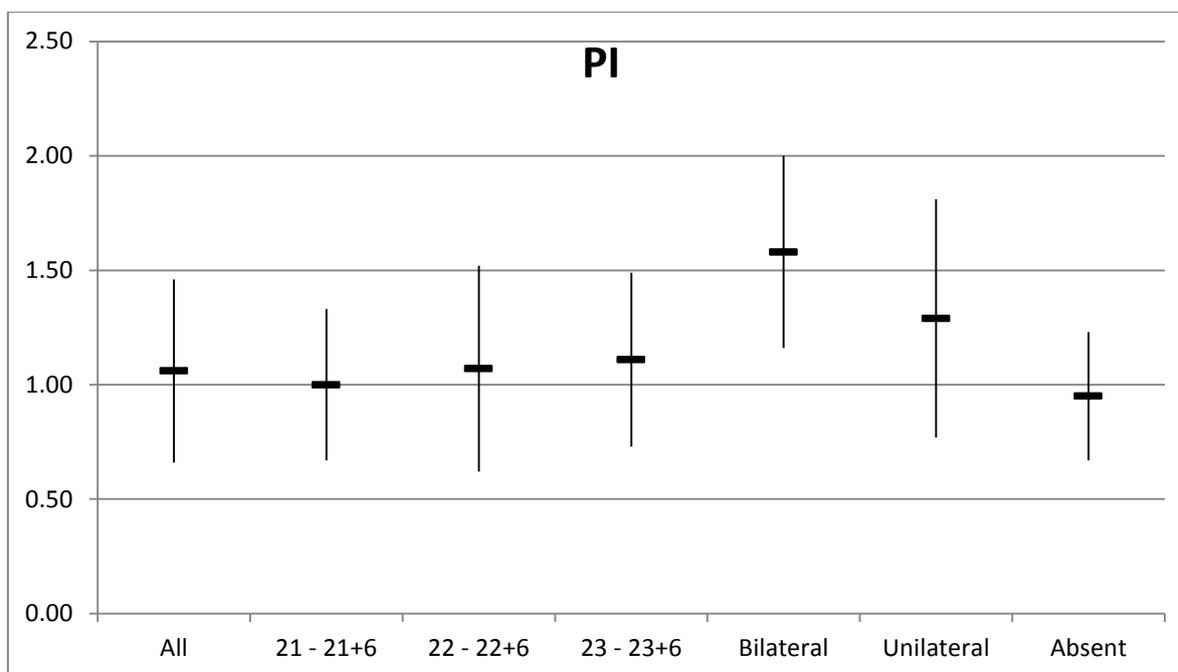


Figure 3. Mean PI±DS

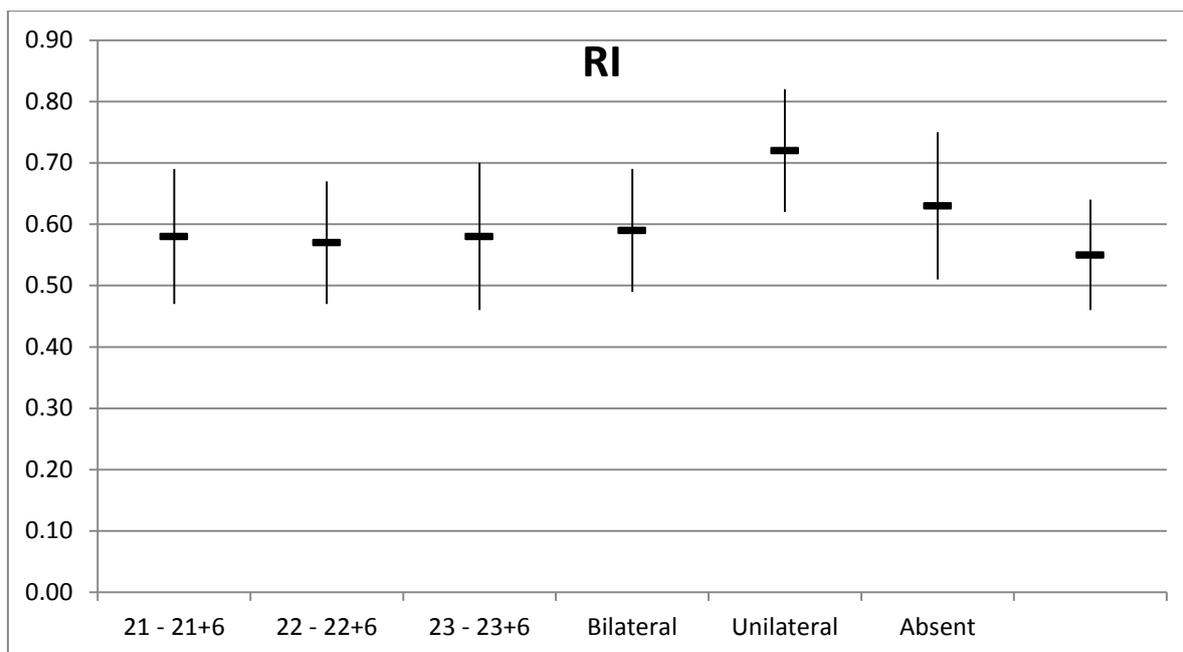


Figure 4. Mean RI±DS

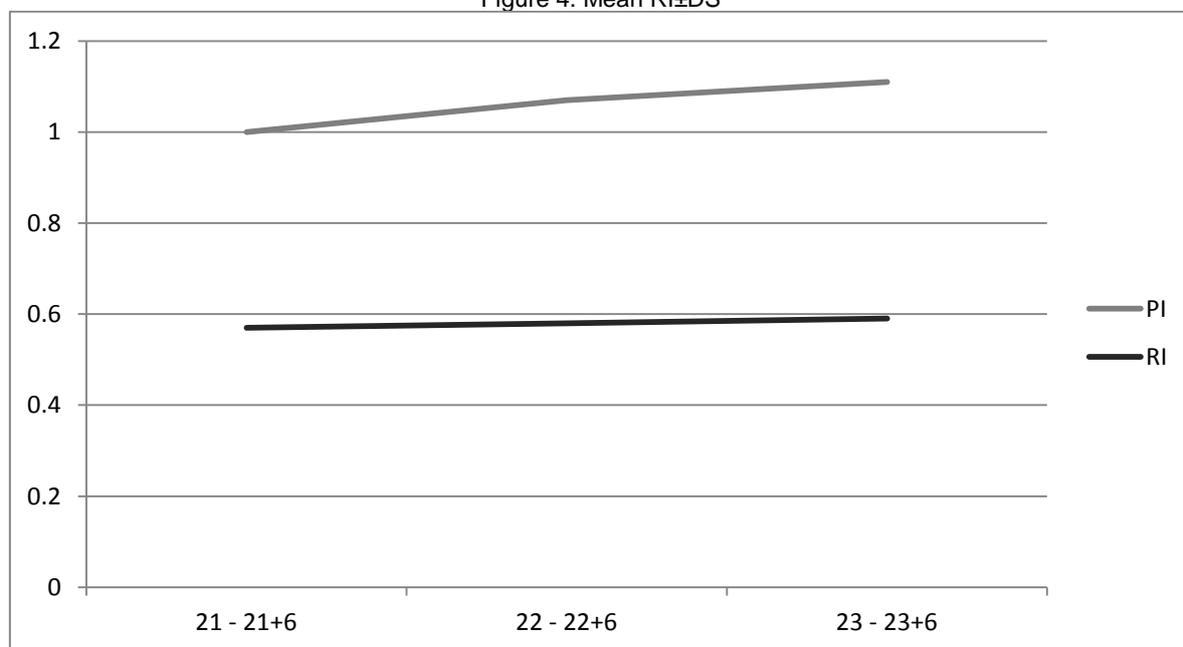


Figure 5. Mean PI and RI if the three gestational age groups

Table 3 and figure 6 present the frequency of different types of uterine artery notching among the three gestational age groups (more than half of the cases with bilateral or unilateral notching are in the 22 weeks + 0 days to 22 weeks + 6 days interval), while

table 4 and figure 7 present the distribution of types of uterine artery notching among the three gestational age groups (the frequency of both types of notching is highest in the 21 weeks + 0 days to 21 weeks + 6 days interval).

Table 3. Distribution of frequency of different types of uterine artery notching among the three gestational age groups

Notching	21 weeks + 0 days to 21 weeks + 6 days (n=17)	22 weeks + 0 days to 22 weeks + 6 days (n=23)	23 weeks + 0 days to 23 weeks + 6 days (n=19)
Bilateral (n=6)	1 (5.88%)	3 (13.04%)	2 (10.53%)
Unilateral (n=9)	1 (5.88%)	5 (21.74%)	3 (15.79%)
Absent (n=44)	15 (88.24%)	15 (65.22%)	14 (73.68%)

Table 4. Distribution of types of uterine artery notching among the three gestational age groups

Notching	Bilateral (n=6)	Unilateral (n=9)	Absent (n=44)
21 weeks + 0 days to 21 weeks + 6 days (n=17)	1 (16.67%)	1 (11.11%)	15 (34.09%)
22 weeks + 0 days to 22 weeks + 6 days (n=23)	3 (50%)	5 (55.56%)	15 (34.09%)
23 weeks + 0 days to 23 weeks + 6 days (n=19)	2 (33.33%)	3 (33.33%)	14 (31.82%)

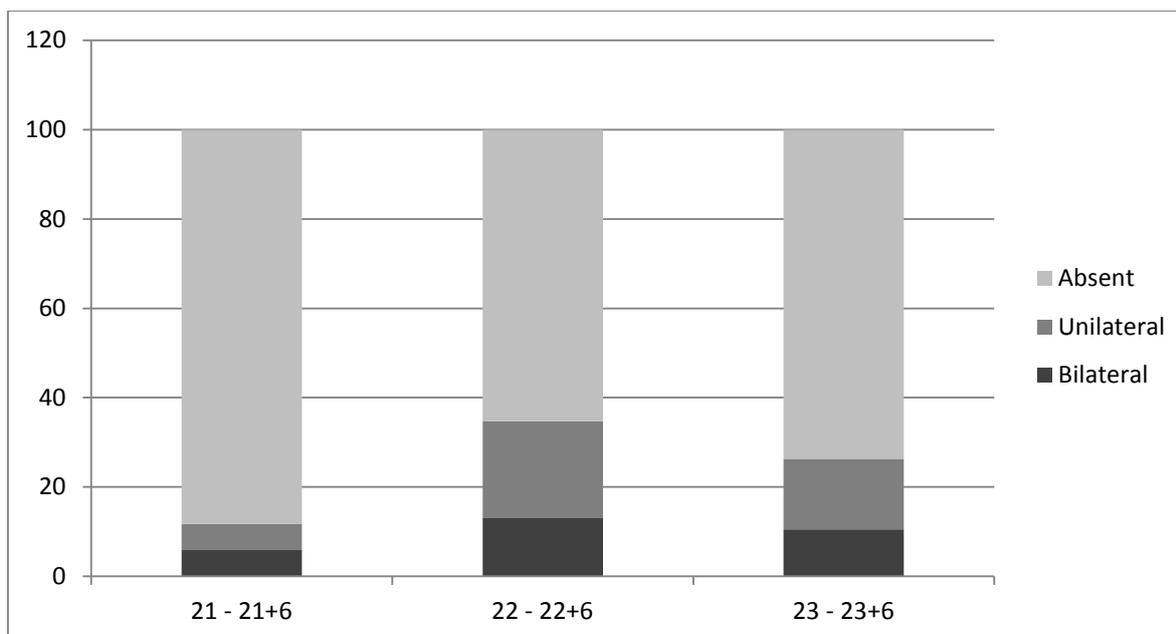


Figure 6. Distribution of frequency of different types of uterine artery notching among the three gestational age groups

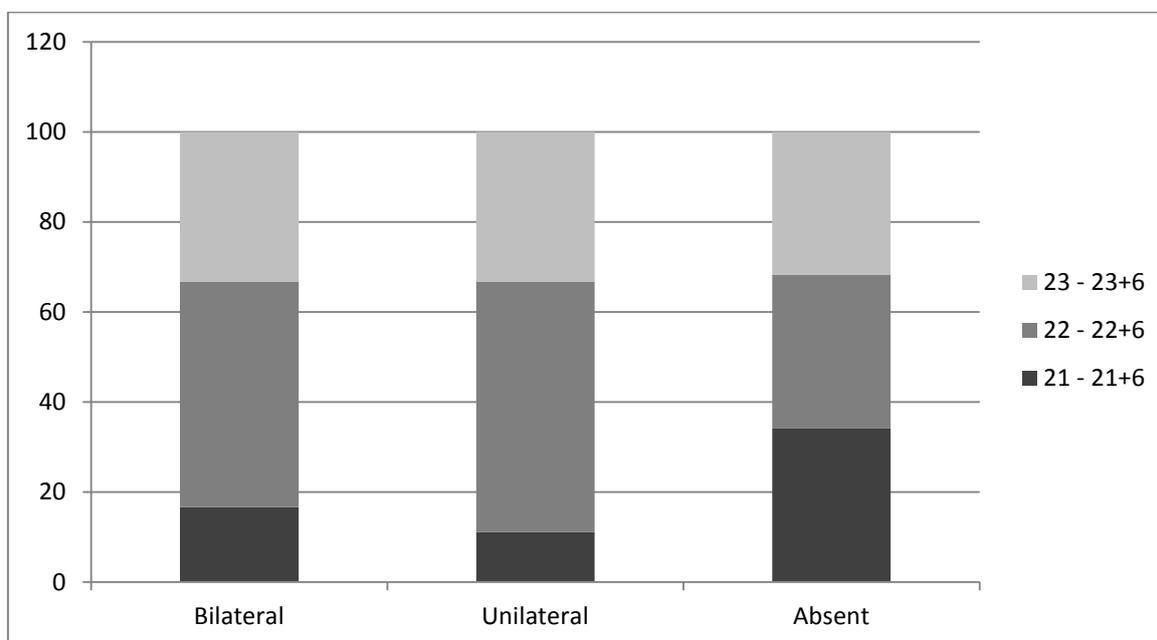


Figure 7. Distribution of types of uterine artery notching among the three gestational age groups

## DISCUSSION, CONCLUSIONS

The mean uterine artery PI and RI vary and the frequency of bilateral and unilateral uterine artery notching vary from 21 weeks + 0 days-21 weeks + 6 days to 23 weeks + 0 days-23 weeks + 6 days. They also decrease from pregnant patients with bilateral uterine artery notching to those without notching.

The frequency of bilateral uterine artery notching in our study is 10.17%,

The results in our study are similar to those in literature:

-mean PI  $1.10 \pm 0.30$ ,  $1.05 \pm 0.27$  (Gómez et al, 2006) and 1.05 and 1.00 at 21 and 22, respectively (Gómez et al, 2006), and 1.41 (Albaiges et al., 2003), 1.09 (Papageorghiou et al., 2002) and 0.96 (Gomez et al., 2008) at 23 weeks

-mean RI 0.67 at 23 weeks (Albaiges et al., 2003)

Our aim is to screen, as much as possible, all pregnant patients between 21 and 24 weeks of pregnancy who are referring to our clinic of pregnancy by uterine artery Doppler ultrasound in order to discover bilateral notching as soon as possible for specific prophylactic treatment to be started.

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