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Parity and Aortic Dimensions in Healthy Women

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Keywords

Pregnancy; parity; aorta; magnetic resonance; aging

Cardiac output and blood volume increase dramatically during the course of normal pregnancy, peaking around the time of parturition¹. In addition to hemodynamic stress, high levels of circulating gestational hormones and angiogenic factors may contribute to increased risk for aortic dissection in late pregnancy, especially in women with Marfan or Turner syndromes². It is unknown whether repeated pregnancies may result in enduring enlargement of aortic diameter in healthy women. Therefore, in this cross-sectional study we investigated the relation between ascending and descending aortic diameters and parity history in 51 healthy female volunteers. Parity was defined as the number of live births. All subjects provided written informed consent for voluntary participation in an IRB-approved protocol. Women with hypertension, congenital or acquired cardiac disease, diabetes, renal or liver disease and history of pregnancy complications such as pre-eclampsia or multiple gestations were excluded from study.

Ascending and descending aortic diameters (AAD, DAD) were measured at the level of the pulmonary artery bifurcation by magnetic resonance (Fig. 1). Age, BSA, and blood pressure were similar in low and high parity groups (Table 1). However, AAD was 13% greater ($P = .001$) and DAD was 10% greater ($P = .001$) in the multiparous group. Multivariable analysis showed that age ($P < .001$), BSA ($P = .004$) and parity ($P = .002$) each contributed significantly to variation in AAD, while age ($P < .001$) and BSA ($P < .001$, but less so parity ($P = .072$) correlated with descending aortic diameter.

The fact that both ascending and descending aortic diameters are larger in healthy multiparous women compared to null or uniparous women suggests the experience of normal pregnancies and births causes enduring changes in the wall structure of the thoracic aorta. High levels of circulating angiogenic factors involved in vascular development of the

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placenta and embryo³ may also induce remodeling of the maternal vasculature to accommodate the increased blood volume of pregnancy. High estrogen and progesterone levels in pregnant women are associated with histological changes in the aortic wall, including fragmentation of reticulin fibers, diminished acid mucopolysaccharides, disruption of elastic fibers, and hypertrophy and hyperplasia of smooth muscle cells⁵. It thus seems plausible that a summation of hormonal and hemodynamic stresses after repeated pregnancies might result in enduring aortic enlargement⁶.

Our sample by design excluded confounders affecting aortic size such as HTN and diabetes⁷. Thus, we were able to discern statistically significant and biologically plausible effects of multiparity on aortic dimensions. However, these observations most likely underestimate the effects of pregnancy on aortic dimensions in the general population with its high prevalence of obesity, diabetes and hypertension. Our findings are important for expanding knowledge about ways in which gender-specific physiological factors such as normal pregnancy may influence cardiovascular biology, and are relevant to assessing pregnancy risks in women that have preexisting conditions associated with aortic complications such as Marfan and Turner syndromes, and bicuspid aortic valve.

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References

1. Abbas AE, Lester SJ, Connolly H. Pregnancy and the cardiovascular system. *International Journal of Cardiology*. 2005; 98(2):179–189. [PubMed: 15686766]
2. Immer FF, Bansi AG, Immer-Bansi AS, et al. Aortic dissection in pregnancy: analysis of risk factors and outcome. *The Annals of Thoracic Surgery*. 2003; 76(1):309–314. [PubMed: 12842575]
3. Wulff C, Wilson H, Dickson S, Wiegand S, Fraser H. Hemochorial placentation in the primate: expression of vascular endothelial growth factor, angiopoietins, and their receptors throughout pregnancy. *Biology of reproduction*. 2002; 66(3):802–812. [PubMed: 11870089]
4. Gibbons GH, Dzau VJ. The emerging concept of vascular remodeling. *The New England journal of medicine*. 1994; 330(20):1431–1438. [PubMed: 8159199]
5. Manalo Estrella P, Barker AE. Histopathologic findings in human aortic media associated with pregnancy. *Archives of pathology*. 1967; 83(4):336–341. [PubMed: 4225694]
6. Nolte JE, Rutherford RB, Nawaz S, Rosenberger A, Speers WC, Krupski WC. Arterial dissections associated with pregnancy. *J Vasc Surg Mar*. 1995; 21(3):515–520.
7. Wolak A, Gransar H, Thomson LEJ, et al. Aortic Size Assessment by Noncontrast Cardiac Computed Tomography: Normal Limits by Age, Gender, and Body Surface Area. *JACC: Cardiovascular Imaging*. 2008; 1(2):200–209. [PubMed: 19356429]
8. Matura L, Ho V, Rosing D, Bondy C. Aortic Dilatation and Dissection in Turner Syndrome. *Circulation*. 2007; 116:1663–1670. [PubMed: 17875973]

Figure 1.

Intraluminal, end-systole aortic diameters were measured on T-1 weighted black blood images at the level of the pulmonary artery bifurcation as previously described⁸. Cross-sectional measurements were made perpendicular (AP) and parallel (RL) to the aortic axis of rotation. AP and RL measurements were averaged to obtain a diameter for ascending and descending aorta for each participant. A single radiologist (A.M.G.) performed all the measurements.

Table 1

Aortic Diameters Stratified by Parity Group

	Low Parity (n = 23)	High Parity (n = 28)	P
Age, years (SD)	43.2 (11.9)	46.0 (12.9)	0.430
White Race, n (%)	16/23 (69.6%)	21/28 (75%)	0.665
Pregnancies (number)	10	72	<0.001
BSA, m ² (SD)	1.67 (0.18)	1.72 (0.16)	0.284
BMI, kg/m ² (SD)	24.9 (5.2)	25.6 (4.2)	0.592*
Systolic blood pressure, mm Hg (SD)	121.3 (16.4)	117.5 (13.8)	0.356*
Diastolic blood pressure, mm Hg (SD)	72.9 (9.7)	69.3 (7.5)	0.147*
Ascending aortic diameter, cm (SD)	2.39 (0.34)	2.67 (0.48)	0.001 [†]
Descending aortic diameter, cm (SD)	1.72 (0.23)	1.88 (0.28)	0.001 [†]

Low parity = no or just one life birth; High parity = two or more live births. BSA, body surface area; BMI, body mass index. Mean values are compared by analysis of variance or *analysis of co-variance (ANCOVA) with age as a covariate or [†]ANCOVA with age and BSA as covariates. Study subjects reported a total of 82 singleton pregnancies, all full term and all but two normal spontaneous vaginal deliveries. Five women had additional pregnancies ending in the 1st trimester through miscarriage or abortion. Parity data (null, n = 13; one, n = 10; two, n = 17; 3–5, n = 11).