

Middle cerebral artery

Anatomical landmarks

With colour Doppler, we can see the circle of Willis at the base of the fetal skull. The middle cerebral artery (MCA) follows an anterolateral course towards the posterior wall and then, towards the external lateral walls of the orbit at the level of the two greater wings of the sphenoid bone. Besides the MCA, other arteries originating from the circle of Willis, namely the anterior and the posterior cerebral arteries, can also be identified and have been the subject of publications.

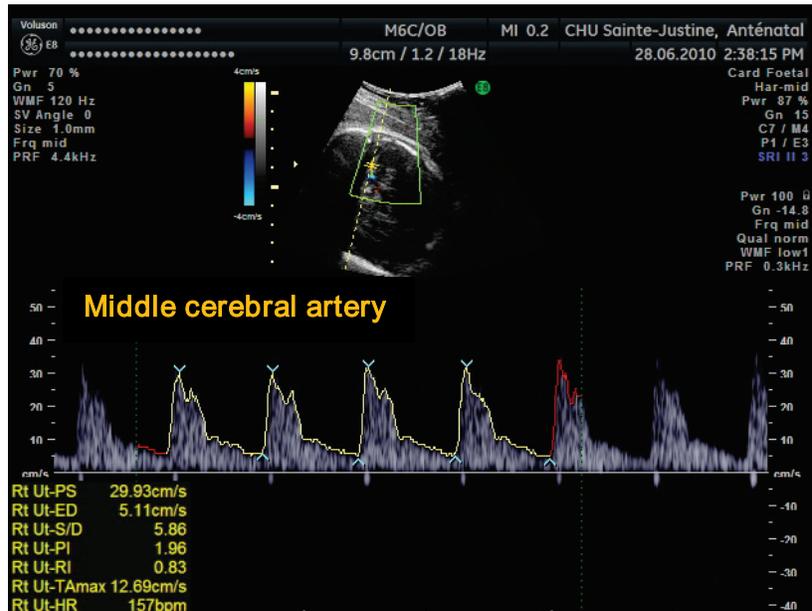
In clinical practice, the middle cerebral artery is the most used artery as it supplies 80% of blood flow of the cerebral hemispheres.

Technical aspects

It is relatively easy to locate the MCA at the level of the circle of Willis. Colour coding makes the exercise quicker and, most importantly, more accurate. The sampling point along the MCA path has been the subject of several publications. Like most centres, we place the Doppler sample volume at the level of the proximal portion of the MCA, at approximately one (1) cm from its origin. Colour Doppler also enables to better evaluate the insonation angle of the artery, which should always be less than 30°. This recommendation is particularly important in fetuses suspected of being anemic, where peak systolic velocity of the Doppler waveform is the marker of interest.

Comparisons between the MCA closest to the probe and the contralateral artery do not reveal any significant difference. Finally, we should stress that to avoid any contamination by nearby vascular structures, the opening size of the Doppler sample should not exceed three (3) mm. Recordings should always be done in the absence of fetal or respiratory movements.

PIAF study: Placental insufficiency and aortic isthmus flow



Parameters and indices

Measurements must always be taken on recording of three to five consecutive cardiac cycles, and an average of these measurements is retained. The pulsatility index and the resistance index, already defined for the umbilical artery, are the most frequently considered indices. During systole, a sustained increment in maximal velocities is observed on middle cerebral artery Doppler tracings of normal fetuses, from 18 weeks until the end of gestation. The diastolic component follows this trend only slightly or even not at all, at least until approximately the 30th week at which time it increases significantly. This particular diastolic profile explains the parabolic curve usually observed on charts showing the pulsatility index of the middle cerebral artery according to gestational age. It is important to remember those differences in the development of cerebral and placental vascular resistances.

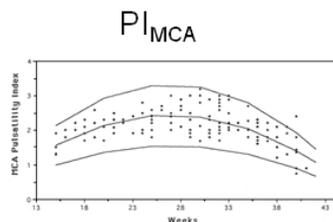
PIAF study: Placental insufficiency and aortic isthmus flow

The cerebroplacental index (CPI) quantifies this relationship. As its name suggests, the CPI is the result of the ratio between the middle cerebral artery pulsatility index and the umbilical artery pulsatility index. Given the number of choices of vessels for building reference charts, for both the cerebral circulation and placental circulation, and considering the influence of the site of Doppler investigation on the arteries (proximal or distal for the MCA, fetal or placental for the umbilical artery), it is essential to consider all those variables to arrive at a reliable clinical interpretation of those measurements. In our Unit, we systematically use the fetal insertion of the cord for the umbilical artery and the proximal portion of the middle cerebral artery to calculate the cerebroplacental index, with the Ebbing chart as reference for normal values.

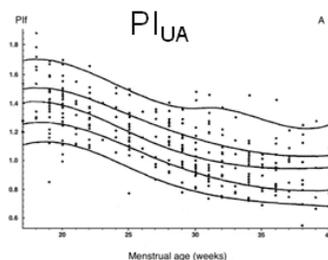
« CPI » Cerebroplacental index

$$\text{CPI} = \frac{\text{PI}_{\text{MCA}}}{\text{PI}_{\text{UA}}}$$

PI_{MCA} = Mean cerebral artery pulsatility index
 PI_{UA} = Umbilical artery pulsatility index



Mari G. *et al.* Am J Obstet Gynecol 1992;166:1262-1270



Sonesson SE *et al.* J Clin Ultrasound 1993; 21: 317-324

CPI

Gestational weeks	Percentiles	
	90 th	95 th
26	2.58	2.78
28	2.79	3.00
30	2.95	3.17
32	3.05	3.27
34	3.06	3.29

Ebbing *et al.* Ultrasound Obstet Gynecol 2007; 30: 287-296