Doppler Studies to Evaluate the Impact of Epidural Analgesia on Fetal Outcomes

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Abstract

Objective: To evaluate the impact of epidural analgesia on fetal condition during labor using objective parameters.

Design: Cross sectional study.

Setting: Kasr Al-Aini Hospital.

Patients and Methods: Pregnant women coming for labor were examined by Doppler studies of umbilical artery and middle cerebral artery before and after epidural analgesia. Follow-up for fetal outcomes were recorded.

Results: There were no significant difference between any of the parameters tested. There was no adverse effects on fetus.

Conclusion: Epidural analgesia seems to be safe regarding progress of labor or fetal outcome.

Key Words: Epidural analgesia – Fetal outcomes.

Introduction

ALTHOUGH delivery is a normal physiologic process, it causes a certain level of pain in women. Today, the most frequently preferred and the most used method is epidural anesthesia for pain control [1]. But various unwanted side effects on the fetus may be associated with its use [2].

With color Doppler technology it became possible to visualize and investigate the main cerebral arteries and to evaluate vascular resistance in various vascular areas of the brain supplied by these arteries. The vessels most easily investigated by this incidence are middle cerebral arteries because they are easily located towards the Doppler transducer in this case the angle between the vessel axis and the Doppler beam is close to zero and Doppler frequency is maximum [3]. The umbilical artery Doppler velocimetry is now considered a test of placental vascular bed resistance, while the middle cerebral artery velocimetry reflects the oxygen status of the fetus by showing the brain sparing effect in cases of ante partum fetal hypoxia. The aim of the present study is to evaluate the Doppler changes before and after epidural analgesia to detect adverse effect on the fetus.

Patients and Methods

The present study was a prospective cross sectional study on women during deliveries in Kasr Al Ainy. Women were their own self controls. Doppler measurements were done before and after Epidural analgesia. The study included only primigravida aged from 20 to 40 years old with singleton pregnancy and cephalic presentation. Multigravidas or those with malpresentations/multiple pregnancies/ medical disorders especially hematological disorders were excluded.

Epidural analgesia procedure

After intravenous preload of 500ml lactate Ringer's Solution, Candidates will receive epidural analgesia after test dose will receive 10ml of a solution containing bupivacaine 0.0625% and 2µg/mL of fentanyl in epidural catheter initially followed by top up doses according to the parturient demand.

All patients were subjected to the following: Thorough history taking with emphasis on the date of last menstrual period to know if sure or not. If the patient has a report of ultrasound in first or early second trimester of pregnancy, it is registered in her file and we depended on it for estimation of gestational age. Ultrasound and Doppler study at the fetomaternal unit, cairouniversity to assess the following: Amniotic fluid volume (AFV), Gestational age determination, Fetal weight estimation,
Middle cerebral artery pulsatility index (MCA-PI), Umbilical artery pulsatility index (UA-PI), Cerebro placental ratio (CPR).

**Doppler examination:**

To measure the MCA, an ultrasound scan of the fetal head was performed to obtain a transverse view at the level that is usually used to measure biparietal diameter (BPD). The transducer was then moved parallel to this plane towards the base of the skull to identify the circle of Willis. At this plane, the MCA is easily demonstrated. Multiple waveforms recordings were obtained and an average of the pulsatility indices (PI) was calculated. A PI below the 5th centile for the MCA was considered abnormal.

**Cerebral Hemodynamics and Doppler Indices:**

The amplitude of the end-diastolic flow in the fetal vessels is directly related to the vascular resistances in the area supplied by these vessels. In order to quantify the vascular resistance various indices, which measure the proportion of systolic flow within the total forward flow (M) during one cardiac cycle, or the relative amplitude of systolic (S) to diastolic (D) flow, have been proposed:

\[ P_I = \frac{S-D}{M} \]
\[ R = \frac{D}{S} \]
\[ R_I = \frac{S-D}{S} \]
\[ R = \frac{S}{D} \]

Most of these parameters change according to the resistance to flow into the vascular territory under investigation; therefore, any increase of indices above the upper limit of the normal range corresponds to an increase of the vascular resistance.

In contrast, the D/S index decreases as the resistance to flow increases. The vascular resistance increases may be due to vascular disease (Placental infarction or fibrosis) or to distal arteriolar vasoconstriction (brain response to increased PO2 or to vasoactive drugs).

Conversely, abnormally decreased resistance to flow values are displayed below the lower limit of the normal range of the index for S-D/M, S-D/S, S/D and above the upper limit for the D/S index. The decreased resistance to flow may be due to the existence of arterio-venous shunts or due to an arteriolar vasodilatation (brain adaptation to hypoxia or to drugs).

**Statistical analysis:**

Data were statistically described in terms of range, mean ± standard deviation, frequencies (number of cases) and percentages when appropriate. Comparison of quantitative variables between the study groups was done using t-student test or Mann Whitteny test where appropriate. The data obtained from both, the study group and the control group, were analyzed statistically using computer programs Microsoft Excel (Microsoft Corporation, NY, USA) and the Statistical Package for Social Science (SPSS) statistical programs (SPSS Inc., Chicago, IL, USA).

**Results**

The effect of epidural analgesia on the Umbilical artery and Middle cerebral artery is illustrated in Table (1). The effect on fetal heart rate is illustrated in Table (2). Instrumental delivery was recorded only forceps was used in only 2 cases of labor.
Table 2: Beat to beat variability in latent and active phase.

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<td>Beat to beat variability</td>
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<td>6.0%</td>
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Discussion

The primary aim of any hemodynamic investigation is to assess the adequacy of organ perfusion. The use of Doppler velocimetry in the study of hemodynamic changes during labor after regional anesthesia/analgesia has been reported [4,5]. These studies have concluded that epidural anesthesia provide effective analgesia during labor without compromising blood flow to the fetus. It is now easy to detect the arterial pulsation of the cerebral vessels and to localize correctly the Doppler sample volume. On the biparietal image plane the middle cerebrals arteries are found on line passing anterior to the cerebral peduncles, and the anterior cerebral arteries, and the posterior communicating arteries are found on a line perpendicular to the previous line approximately 2cm in front of the peduncles anterior limit [6].

In the present study, the effect of epidural on the Umbilical artery Resistance Index (RI) and Pulsatility Index (PI) were recorded and found that both decreased after than before after epidural in both active and latent phases of labor; however in latent phase it decreases more than the active phase. The effect of epidural on the Middle cerebals artery resistance index (MCA) was also recorded and was nearly the same after and before epidural in both active and latent phases of labor. The best results were observed with levobupivacaine, followed by bupivacaine, then ropivacaine. In general, the improvement of fetal and placental blood flow reflects the epidural induced vasodilatation and increased blood flow.

Other investigators also performed a study concluding that Epidural sufentanil and bupivacaine provide effective analgesia with acceptable side effects during the first stage of labor in healthy parturients. Neither drug had any detrimental effects on blood flow indexes reflecting peripheral vascular resistance in the umbilical and uterine arteries in healthy parturient [7].

Fetal accelerations were positive in 96% of active phase group and 100% in latent phase group, p-value was 0.49. Regarding fetal decelerations; it was positive in 8% of active phase group and 4% in latent phase group p-value was 0.4, also fetal Beat to beat variability was positive in 94% of active & latent phase group p-value was 1. These results were not of significant value.

These findings are supported by other investigators who performed a study in which combined spinal and epidural (CSE) using intrathecal sufentanil (7.5microg); and CSE using intrathecal bupivacaine (2.5mg) and sufentanil (1.5microg). Charts were evaluated for nonreassuring fetal heart tracings and uterine hyperactivity as well as for neonatal and labor outcome. He concluded that Intrathecal sufentanil (7.5microg) produced significantly more nonreassuring tracings and uterine hyperactivity. However, this did not result in more cesarean deliveries or detrimental neonatal outcome. Based on this retrospective analysis, we conclude that intrathecal sufentanil in a dose of 7.5microg has the potential to result in more non reassuring fetal heart rate tracings compared with both intrathecal analgesia using a bupivacaine (2.5mg)/sufentanil (1.5microg) mixture and epidural analgesia using bupivacaine, sufentanil, and epinephrine [8].

In conclusion, epidural analgesia allows better fetal blood flow as it decreases the umbilical artery resistance index after the epidural in both latent and active phases, however no difference in pulsatility index of umbilical artery and values of middle cerebral artery. In addition, epidural analgesia does not affect fetal heart rate variability or pattern.

References

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