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EFFECT OF MOBILE PHONE RADIATION ON ANTENATAL CARDIOTOCOGRAPHY AT 40 WEEKS AND MATERNAL AND NEONATAL OUTCOME

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ABSTRACT

Objective: To study the effect of mobile phones on fetal cardiotocographic parameters.

Material and Methods: One hundred and forty one low risk antenatal women at forty weeks of gestation were studied for the cardiotocographic changes after exposure to the Nokia 100 mobile phone, kept at 20 cm distance from the woman's abdomen. Comparison of the cardiotocographic parameters after placement of mobile device was done. The maternal and neonatal outcome was compared with the retrospective data analysis of women with similar antenatal profile.

Results: Significant difference was seen with increase in cardiac parameters after placement of the mobile device. There was decrease in the number of caesarean delivery in these women, though there was no significant change in the perinatal outcome.

Conclusion: Use of mobile phones in the vicinity of the term fetus causes increase in fetal cardiac activity and is associated with reduced caesarean delivery rates, but causes no change in the perinatal outcome.

KEYWORDS : Mobile phone during pregnancy, Effect of mobile phone on fetus, Mobile phone and fetal cardiac activity

Introduction:

The effect of mobile phone radiation on human health is the subject of recent interest and study, as a result of the enormous increase in mobile phone usage throughout the world (more than 7 billion subscriptions worldwide are estimated by the end of 20151). Mobile phone device has become an essential part of daily life for all including the pregnant women. Alongside this, there are hundreds of, apparently conflicting, reports in the media about the health effects of mobile phones. The fetus may be more vulnerable because of the developing nervous system, the greater absorption of energy in the tissues of the head, and a longer lifetime of exposure.

Mobile phones use electromagnetic non ionising radiation, in the microwave range. Mobile phones communicate by transmitting radio waves through a network of fixed antennas called base stations. Radiofrequency waves are electromagnetic fields, and unlike ionizing radiation such as X-rays or gamma rays, can neither break chemical bonds nor cause ionization in the human body[2]. The radio waves emitted by a Global System for Mobile Communication(GSM) handset can have a peak power of 2 watts.

One well understood effect of microwave radiation is dielectric heating, in which any dielectric material (such as living tissue) is heated by rotations of polar molecules induced by theelectromagnetic field. In this case, the level of temperature increase is an order of magnitude less than that obtained during the exposure of the head to direct sunlight. The brain's blood circulation is capable of disposing of excess heat by increasing local blood flow. The communications protocols used by mobile phones often result in low frequency pulsing of the carrier signal. Whether these modulations have biological significance has been subject todebate[3].Studies conducted using fluorodeoxyglucose injections and positron emission tomography concluded that exposure to radiofrequency signal waves within parts of the brain closest to the cell phone antenna resulted in increased levels of glucose metabolism, but the clinical significance of this finding is unknown[4,5].

Radiofrequency exposure limits for mobile phone users are given in terms of SpecificAbsorption Rate (SAR) – the rate of radiofrequency energy absorption per unit mass of the body. Currently, two international bodies[6,7] have developed exposure guidelines for workers and for the general public, based on a detailed assessment of the available scientific evidence.

The present study was planned to study the effect of use of mobile phones on fetal cardiotocographic parameters and to study the maternal and neonatal outcome in pregnancies exposed to mobile phone.

Material and Methods:

The study was performed in a secondary health centre with approximately 100 deliveries per month. All women were induced at forty weeks of pregnancy as per the protocol if not gone into labour prior. Gestational age was calculated by transvaginal ultrasound done at 8 weeks of pregnancy. Admission testing with cardiotocograph (CTG) trace was obtained for all women. Consecutive consenting one hundred and fifty antenatal women admitted for induction of labour at forty weeks of pregnancy were recruited for the study for a period of six months and were labelled as Group I. Informed consent was obtained prior to inclusion in the study. The approval was obtained from the Institutional Ethics Committee. Labour was induced with 0.5 mg of dinoprostone prostaglandin E2 intracervical gel for all the women at 6.00 am in the morning after admission. At this point of time, prior to induction of labour, an empty cardboard box was kept at 20 cm distance from the woman's abdomen on the lateral side opposite to that of CTG machine. The CTG trace was taken for first 10 minutes.The box was checked and the CTG trace was marked at every 5 minute interval for a period of next 40 minutes. This time period in CTG is labelled as “no phone” in this study. After a period of 10 min, aNokia 100 mobile phone device with the operating frequency of GSM 900and 1800 MHz and SAR between 0.45 watts/m^2 and 0.9 watts /$m^2$was kept inside the box at the same location in a “switched “off” mode without the woman being aware. The CTG trace was taken for next 10 minutes with the phone device switched “off”. This time period is labelled as “phone off”.The device was then switched “on” without the knowledge of the women and the trace was continued for next 10 minutes. This time period is labelled as “phone on”. It was planned to take away the phone device immediately, if after any of these transitions showed conversion to non reassuring or pathological pattern, and assess the fetus for well being and take necessary action if warranted. Such events were to be noted seperately. The device was again switched “off” and CTG trace was continued for further 10 minutes. This period is noted as “repeat phone off”. The single mobile device was used for all the women. The 40 minute CTG trace obtained was saved in the records to be reported in four parts, each of 10 minute duration, by the consultant blinded to the status of the mobile phone inside the box. The women were followed for development of maternal and fetal complications till the delivery and the neonate were studied for APGAR score at 5 minutes, number of days of admission in the intensive care unit, development of hyperbilirubinemia and any other complications developed during the first 3 days of life. For comparing the neonatal outcome of these women with others without exposure to the mobile phone radiation, maternal and neonatal data was obtained from the same number of hospital records from the previous six months. The last low risk antenatal women admitted at forty weeks for induction of labourwith reassuring admission test in the previous six months were selected for the comparison and were labeled as group II.

Failed induction was diagnosed when labour was not established after two doses of intracervical dinoprostone gel, the second being inserted

in the absence of response, 6 hours after the first dose. Liquor was defined by the consultant as stained with meconium even with minimal stain or flakes of meconium as seen on clean white sterile dressing pad. The diagnosis of abruptio placentae was suspected in the presence of antepartum haemorrhage with placenta situated in the upper segment as seen in ultrasonography and confirmed only with the presence of retroplacental clot seen after delivery of placenta.

Statistical analysis using paired t-test was done to compare the baseline heart rate, beat to beat variability, number of accelerations, amplitude and duration of the largest acceleration before and after the placement of mobile device. The maternal characteristics and neonatal outcome in these women was compared with the retrospective data analysis of low risk women using Chi- Square test.

Results

There were 610 deliveries during the study period of six months out of which 278 were induced labours. Out of 150 recruited women, nine had non reassuring or pathological trace at admission as per the NICE guideline[8] and were excluded, thus leaving one hundred and forty one women for analysis.The mean age of these women was 28.5 years. Ninety eight out of 141 women (69.5%) were primiparous and rest multiparous. None of these women had any obstetric complication or medical disorder during their pregnancy.

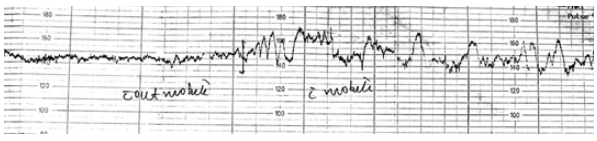
There was no significant difference seen in the baseline heartrate, beat to beat variability, accelerations and the amplitude in the CTG trace between the "no phone" and "phone off" time zone. However, statistically significant difference was found in the baseline heartrate, beat to beat variability, accelerations and the amplitude of the CTG trace after switching "on" the mobile devicebetween the "phone off" and the "phone on" zone showing increase in the cardiac activity, as depicted in Table 1.

Table 1: Comparison of Cardiotocographic features

CTG Feature (Mean ± SD)	Phone "off" zone	Phone "on" zone	Significance
Baseline Heart Rate(beats/min)	140 ± 5	152±5	p<0.00001
Beat to Beat Variability(beats)	8 ± 3.3	22.5 ± 5	p<0.00001
No. of accelerations(no.)	2.6 ± 0.33	3.9 ± 2.1	p<0.00001
Amplitude(beats)	20.4 ± 7.5	32.5 ± 27.5	p<0.00001
Duration(sec)	20.2 ± 7.5	45.03±27.5	p<0.00001

Cardiotocographic trace of one of the women showing the changes is shown in Figure 1.

Fig.1



The increased beat to beat variability and the amplitude of the accelerations remained increased during"repeat phone off" zone of CTG showing no significant difference between "phone on" and "repeat phone off", whereas the baseline heartrate and the number of accelerations reduced to the "phone off" period.

During the six months prior to the study, labour was induced in 248 women. Twelve women were excluded due to non reassuring admission test, leaving 236 women. Out of these 236 women, the data of last 140 women was taken for comparison with the study group. There was no statistically significant difference found between the maternal characteristics of these women and those who were exposed to mobile device. No significant difference was seen in the maternal and fetal complications. Significantly reduced rates of caesarean delivery were found in women exposed to mobile device, as depicted in Table 2.

Table 2: Comparison of maternal and fetal complications

Feature/Complications (No.)	Group I	Group II	Significance
Pathological CTG	2	0	P=0.155, NS
Meconium stained liquor	3	3	NS
Abruptio placentae	0	1	P=0.316, NS
Failed induction	8	13	P=0.256, NS
Caesarean delivery	49	31	P<0.05, Significant
APGAR Score< 5 at 5'	0	0	NS
Birth weight (in grams) Mean ± SD	3057 ± 393	3051 ± 363	NS
Female Sex of baby	77	70	P=0.404, NS
Neonatal complications	nil	nil	

Conclusion:

The study shows that use of mobile phones in the vicinity of the term fetus causes increase in short term fetal cardiac activity in the form of increase in baseline heart rate, beat to beat variability, number, duration and amplitude of accelerations, and is associated with reduced caesarean rates, and does not cause any change in the perinatal outcome.

Discussion

The above mentioned effects can be either due to the thermal effect or the pulsing of the carrier signal or even due to the increased glucose metabolism as seen with mobile phone radiation[3-5]. The exact cause of these effects remains unknown and needs further research. The SAR between 0.45 watts/m^2 and 0.9 watts/m^2 in this study is the usual SAR from the regular mobile phones used by the general public.

In this study, though the random alternating of switching "on" the mobile phone for initial trace and then "off" would have shown better comparability, but was not practiced to avoid any emergency interventions due to unknown effects of exposure of mobile phone radiation.

There is now scientific evidence, which suggests that there may be biological effects occurring at exposures below the guidelines. This does not necessarily mean that these effects lead to disease or injury, but it is potentially important information with significant implications. Populations as a whole are not genetically homogeneous and people can vary in their susceptibility to environmental hazards. It is not possible at present to say that exposure to RF radiation is totally without potential adverse health effects. The gaps in knowledge are sufficient to justify a precautionary approach. We recommend that a precautionary approach to the use of mobile phone technologies be adopted until more scientifically robust information is available. There is now evidence that effects on biological functions, including those of the brain, may be induced by RF radiation at levels comparable to those associated with the use of mobile phones. However, there is no evidence that these biological effects constitute a health hazard. But at present only limited data are available. Second, pulsed nature of the signals from mobile phones may have an impact on brain function. Research should concentrate on signal modulations representative of phone technology. Shields and devices that attach to phones seek to reduce exposure to RF radiation. Hands-free extensions have the potential for reducing exposure. A satisfactory design may involve the use of chokes or filters. A standard testing procedure should be established.

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