Periodontal disease is not associated with poor pregnancy outcome

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Abstract

This study investigates the relationship between maternal periodontal disease and intrauterine growth restriction and preterm labour. Periodontal disease was assessed by bleeding on probing indices. Periodontal bleeding did not correlate with either preterm labour or intrauterine growth restriction (using a corrected birth weight of <5th percentile).

Introduction

Intrauterine growth restriction (IUGR) is a pregnancy related complication characterised by failure of the fetus in attaining its growth potential. IUGR is responsible for considerable perinatal mortality and morbidity. These infants are at an increased risk of perinatal complications such as fetal distress, asphyxia, neonatal encephalopathy, hypothermia, hypoglycaemia and poor feeding, as well as risks of long term neurological and developmental disorders (Chamberlain *et al* 1978, Villar *et al* 1982). These direct effects of IUGR have massive implications for the delivery of health care (Lewit & Baker 1995). Moreover, IUGR carries healthcare implications in adult life, with offspring having an increased risk of hypertension, coronary heart disease and diabetes (Osmond & Barker 2000). These diseases may be consequences of 'programming', whereby a stimulus or insult at a crucial, sensitive period of early life has permanent effects on body size and proportions, and on a range of physiological processes. Socioeconomic deprivation and lack of maternal social support influences fetal growth (Feldman *et al* 2000); in a recent review, Kramer commented, "one of the most robust findings in epidemiological research in the aetiology of low birthweight is the large socioeconomic disparities in both IUGR and preterm birth" (Kramer 1998).

Chronic oral infections are also more prevalent in populations of low socioeconomic status, and have been implicated as causative agents in a variety of systemic illnesses including atherosclerotic cardiovascular disease and cerebrovascular ischaemia (Beck *et al* 1998, Beck *et al* 1999). In addition, periodontal disease in pregnancy has been associated with low birthweight infants (Offenbacher *et al* 1996, Dasanayake 1998, Davenport *et al* 1998). Offenbacher *et al* speculated that a chronic gram-negative bacteraemia could influence placental function via the production of inflammatory mediators (prostaglandin E2 and Tumour necrosis factor-α) (Offenbacher *et al* 1998). Use of a pregnant hamster model demonstrated that localised, non-disseminating subcutaneous infection with Porphyromonas gingivalis caused placental necrosis and reduced placental weights (Collins *et al* 1994).

The strength of the association between periodontal disease and IUGR (and indeed the validity of the association) is unclear. Previous studies have investigated the incidence of low birthweight – defined as a birthweight below 2500g – without controlling for gestational age or other independent determinants of birthweight: fetal sex, parity, ethnic origin, maternal height and booking weight (Offenbacher *et al* 1996, Dasanayake 1998, Davenport *et al* 1998). There are also difficulties in extrapolating from studies performed in the developing world (Dasanayake 1998), which focused on periodontal disease at/after delivery, rather than from early pregnancy (Offenbacher *et al* 1996, Dasanayake 1998).

In this study, birthweight was assessed using the individualised birthweight ratio (IBR). This ratio relates to a predicted birthweight calculated using independent coefficients for gestation at delivery – fetal sex, parity, ethnic origin, maternal height and booking weight – and enables a more accurate prediction of pregnancies which end in a poor outcome than if 'birthweight for gestational age' is used (Wilcox *et al* 1993).

We investigated the hypothesis that periodontal disease in pregnancy is associated with IUGR, by performing a prospective observational study. Associations with periodontal disease and preterm

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labour have also been reported (Beck *et al* 1998, Boggess *et al* 2003). Although the study was powered on the basis of differences in IUGR, other adverse pregnancy outcomes were compared.

Methods

Women were recruited at their initial appointment at the antenatal clinic at St Mary's Hospital, Manchester. Recruitment was carried out by a research midwife (DT) and a clinical research fellow (JN). Each subject was provided with a written information sheet and informed consent obtained. Non-English speaking subjects were offered a translation service, including a patient information sheet in their own language.

To limit the effect of confounding variables (previous poor pregnancy outcome/IUGR, parity) the study was confined to nulliparous patients and non-smokers. Women who were unable to consent and those with a multiple pregnancy or maternal disease (e.g. chronic hypertension, diabetes, renal compromise) were excluded from the study. Subjects' weight, height, ethnicity and whether or not they smoked was recorded at this stage. Ethnicity was an important confounding variable within our population. At recruitment, questions regarding ethnicity were in accordance with those used in the National Census and this also facilitated the calculation of the IBR. The pregnancy was dated by ultrasound scan at less than 20 weeks.

A basic periodontal examination was performed in the antenatal clinic between 8 and 19 weeks' gestation by a dedicated dental hygienist (RH) and nurse (JW). A periodontal examination was performed on all teeth. Missing and partially erupted teeth were noted and later excluded from the periodontal assessment. A WHO probe with a ball end of 0.5mm in diameter and black marking or 'bands' to accurately estimate the depth of the periodontal pockets was used. The level of periodontal disease was categorised into one of five bands using Community Periodontal Index of Treatment Need (CPITN) score 0–4 (Ainamo *et al* 1982); severe disease was defined as CPITN 4 when pocket depths of 6mm or more were present.

Collection of pregnancy outcome information was performed by a research midwife (DT) and a clinical research fellow (JN). Data collected included gestational age at delivery, sex and weight of the baby. Delivery data was collected from the St Mary's Hospital database (CMiS) or the subjects' general practitioner if they delivered at another unit. The individualised birthweight ratio (IBR) was calculated using a Gestation Related Optimal Weight software package produced by the Perinatal Research Monitoring Unit, Nottingham University. There were three poor pregnancy outcome groups: preterm labour under 32 weeks, preterm labour under 37 weeks and IUGR defined as an IBR of less than or equal to 5. Preterm labour is historically defined as under 37 weeks' gestation but with improved neonatal care it is those under 32 weeks' gestation that are most at risk of perinatal mortality and long-term morbidity.

Statistical Methods

When an area of similarly mixed ethnicity and socioeconomic deprivation was studied, the incidence of periodontal disease was significantly higher than the national figures. Amongst pregnant women the prevalence of CPITN score 4 was almost 50 per cent, and none of the women studied were free of any periodontal disease (Davenport *et al* 1998). Previous studies have suggested that maternal periodontal disease is associated with a 3–7-fold increase in the incidence of low birthweight babies (Offenbacher *et al* 1996, Dasanayake 1998). If the prevalence of CPITN score 4 is 40 per cent, a sample size of 300 will detect an increase in the incidence of IUGR from 5 to 15 per cent (or a reduction in the IBR of 0.3 standardised differences), with 80 per cent power, at a 5 per cent level of confidence (Altman 1999).

Data was analysed using SPSS (Statistical Package for Social Sciences for Unix, SPSS Inc., Chicago, Illinois). Two tests were utilised to detect any association between periodontal disease and pregnancy outcomes. Findings were also stratified according to ethnicity and smoking status. Odds ratios were calculated with 95 per cent confidence interval. Results were defined as significant if $p<0.05$.

Results

Demographic, clinical and periodontal data was collected from 300 women of mean maternal age 26.6 years (SD 5.35). Delivery data was not available from five women and six women were excluded due to two late miscarriages, three terminations for fetal abnormalities and one neonatal death as a result of a severe congenital abnormality. This resulted in a complete data set for 289 women.

The prevalence of periodontal disease within our population was very low. All participants had a pocket depth less than 2.5mm. The mean scores of pocket depth were 0.7mm (SD 0.4). As all pregnant women had bleeding ginigiva, participants were classified according to percentage of bleeding sites: 159 women (55%) bled from less than 50 per cent of sites assessed and 130 women (45%) bled from more than 50 per cent of sites assessed.

Tables 1 and 2 compare pregnancy outcome: gestation <37 weeks, gestation <32 weeks and IBR <5; with the <50% or >50% of bleeding sites groups. The incidence of preterm labour (<32 weeks) and IUGR (IBR<5) in the study population was 3% and 28%.

Gestation at <37 and >37 weeks when compared with bleeding sites at <50 and >50 per cent did

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TABLE 1: Effect of gingivitis on intrauterine growth restriction

All subjects n=289	Localised gingivitis n=159	Generalised gingivitis n=130	P value
IBR <5	19 (12%)	19 (15%)	
IBR >5	140 (88%)	111 (85%)	p=0.31

TABLE 2: Effect of gingivitis on preterm labour

All subjects n=289	Localised gingivitis n=159	Generalised gingivitis n=130	P value
Preterm labour <37 weeks	14 (9%)	10 (8%)	p=0.13
Preterm labour >37 weeks	145 (91%)	120 (92%)	
Preterm labour <32 weeks	1 (1%)	3 (2%)	p=0.22
Preterm labour >32 weeks	158 (99%)	127 (98%)	

not bear statistical significance (p=0.13). Similar statistically non-significant results were observed with gestational ages of <32 and >32 weeks (p=0.22). When comparing IUGR/IBR <5th percentile and >50 per cent bleeding sites, the results were once again non-significant with p=0.31.

Discussion

In this study, the prevalence of periodontal disease was considerably lower than expected. St Mary's Hospital, Manchester, serves an area of marked social deprivation, ranked 7th/354 of the most deprived Local Authority Districts in England and 30 per cent of the population are of black or ethnic minority origin. All participants had periodontal pocket depth less than 2.5mm. The incidence of a CPITN score of 4 indicating one or more pocket depth of >6mm was zero.

Davenport *et al* in 1998 reported prevalence of a CPITN score of 4 at almost 50 per cent in a group of similarly mixed ethnicity and socioeconomic deprivation in East London and none of the women studied were free of any periodontal disease (Davenport *et al* 1998). More recently, Moore *et al* (2001) studied the population served by Guy's and St Thomas's Hospitals Trust in London and reported rates of 13.9 per cent (one or more 6mm pocket depth) for severe periodontal disease (Moore *et al* 2004).

A recent systematic review into the association between periodontal disease and adverse pregnancy outcome identified six studies that suggested periodontal disease as a risk factor for low birthweight, odds ratios and relative risks ranging from 1.1 to 7.2 (Xiong *et al* 2006). However, a British cohort of 3738 pregnancies found no such association (Moore *et al* 2004). In these studies, the obstetric outcome low birthweight was defined as less than 2500g at term (37 weeks onwards). This is not a measure of intrauterine growth restriction and therefore unhelpful, as IUGR is responsible for considerable perinatal mortality and morbidity. Our study uses the more accurate assessment of growth restriction, the IBR.

Low birthweight is a predictor of perinatal morbidity and mortality and is better than gestational age alone. However, for a given birthweight a greater gestational age decreases the risk. Using a birthweight of less than 2500g has been shown to be a poor predictor of perinatal outcome (Patterson *et al* 1986). It creates the problem of identifying as growth retarded those infants who are normally grown and constitutionally small. It also excludes larger infants who are truly growth retarded.

For a given gestational age, an individual baby has an intrinsic birthweight potential, which it achieves, under achieves or over achieves. The IBR calculates a baby's predicted birthweight using weight at delivery, gestation at delivery, baby's sex and maternal height, weight, ethnicity and parity. The baby's actual birthweight is divided by the predicted weight and expressed as a percentage. The computer program used to calculate the IBR includes coefficients for physiological variables from 40,000 pregnancies derived from Nottingham. A similar program based on Manchester data is currently not available but is being developed.

Detailed neonatal examination, Ponderal Index and skinfold thickness are better at identifying growth restricted babies than birthweight centile charts or birthweight <2500g (Patterson & Pouliot 1987). These neonatal measurements are time-consuming and require experienced staff trained in standardised techniques to obtain reliable reproducible results. The IBR correlates well with these measurements and therefore can accurately determine babies who are growth restricted from those who are constitutionally small (Sanderson *et al* 1994). Individual birthweight centiles are more likely to detect adverse perinatal outcomes than population-based birthweight standards (de Jong *et al* 1998, Clausson *et al* 2001, McCowan *et al* 2005).

Using the IBR, babies previously classified as growth restricted may be classified as normal and those previously regarded as normal may be redefined as growth restricted. Our study illustrates this: 269 women delivered at term (>37 weeks), 8 babies had a birthweight of <2500g of which 2 had an IBR greater than 5. With an IBR <5, 26/269 babies were classified as growth restricted and 16/26 had a birthweight greater than 2500g, mean 2562g, range 1600 to 3090g (SD 345.3g).

Periodontal disease is not associated with intrauterine growth restriction. We question the validity of previous studies that have associated periodontal

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disease with low birthweight (Dasanayake 1998, Davenport *et al* 1998, Moore *et al* 2004, Xiong *et al* 2006). It is important that growth restricted infants are accurately recognised so that studies produce reliable results and interventions can be targeted to where they would have most clinical impact.

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