The ex-vivo dual placental perfusion technique is currently used to study not only organ functions but also transfer profile and metabolic pathways of different compounds. Placental hypoxia is associated with impaired uterine arteries invasion, poor vili development, loss of vascularity, reduced spiral artery remodeling as well as complications of pregnancy including, hypertension, preeclampsia, oxidative stress, and intrauterine growth restriction, among others pathologies (Figure 1).

Raman spectroscopy (RS) is the methodology which allows for an investigation of physiology at cellular and tissue levels using photon scattering. It is a non-destructive and non-invasive method. Each peak in a Raman spectrum is associated with a unique part of the molecule. RS is a non-invasive tool for chemical identification and analysis. A cross-sectional illustration of fetal venous perfusate, featuring delivery tubing for fetal and maternal-side perfusion and the collection of maternal and fetal-side venous perfusates (Figure 2, Monograph, Introduction of Raman spectroscopy, Metrohm, USA).

OBJECTIVES

1) To analyze fetal perfusates using Raman spectroscopy (Mira M-1) in the in-vitro model of maternoplacental hypoxia ex-vivo human dual placental perfusion. 2) To compare Raman spectra of hypoxic and normoxic perfusates at different time intervals.

INTRODUCTION

The dual placental perfusion model is currently used to study not only organ functions but also transfer profile and metabolic pathways of different compounds. Placental hypoxia is associated with impaired uterine arteries invasion, poor vili development, loss of vascularity, reduced spiral artery remodeling as well as complications of pregnancy including, hypertension, preeclampsia, oxidative stress, and intrauterine growth restriction, among others pathologies (Figure 1).

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RESULTS

Earle’s bicarbonate buffer containing 5.6mM glucose, 0.5mM dextran 70, 0.017mM bovine serum albumin and 5000 IU/I heparin was used as perfusate and equilibrated to the appropriate oxygen tension. The collected hypoxic and normoxic perfusates at different time intervals, pattern at the wave lengths 24390 nm, 19230 nm, 16666 nm, 11900 nm, 10800 nm, 9090 nm and 6150 nm showed the differences in the amplitude.

Table 1: Intensity of Raman spectra signal in fetal perfusates, obtained from in-vitro dual placental perfusion model of hypoxia

<table>
<thead>
<tr>
<th>Condition</th>
<th>Hypoxia (n=6)</th>
<th>Normoxia (n=5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>214.525</td>
<td>225.954</td>
</tr>
<tr>
<td>STDEV</td>
<td>158.7</td>
<td>195.6</td>
</tr>
<tr>
<td>SEM</td>
<td>1.64</td>
<td>4.485</td>
</tr>
<tr>
<td>P</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

*Independent sample t-test, significance set at P<0.05

CONCLUSIONS

The two RS fingerprint patterns represent unique preliminary data, utilizing a potentially new obstetric technology which could help diagnose the duration of placental hypoxia, ultimately providing novel targets for the treatment and prognosis of placental related disorders.

REFERENCES

2. Bennett C, Sibony O, 2006
5. Schneider H, Panigel M, Dancis J, 1972
6. Stolzenberg, L 2013

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