# INTRODUCTION

- Optimal placental oxygen transfer is critical for fetal growth
- Placental oxygen transfer and oxygen consumption are determined among other parameters by fetal and maternal flow rates.
- It has been calculated, that in the artificial system of ex vivo placental perfusion the physiological flow rate in 35 g placental tissue would be 12 ml/min.

# OBJECTIVE

To estimate fetal oxygen transfer in relation to perfusion flow ratio in dually perfused human placenta

# MATERIALS AND METHODS

Three placentas were obtained within one minute after delivery according to the Institutional Review board-approved protocol. Cannulation of the cotyledon and beginning of the perfusion was within 7-10 min after delivery. After initial quality checks and stabilization, the dual perfusion was established with continuous monitoring of the fetal in- and outflow, placental tissue and maternal inflow oxygenation, using sensor array (FisextingO2, Pyo Science, Germany). Fetal-to-maternal leakage was controlled by injection of FITC-conjugated dextran to the fetal circuit. Continuous monitoring of lactate, glucose, pH and temperature was performed. Fetal flow rate was increased from 4.8 ml/min to 12 ml/min in five-seven minute increments. Formula for calculation of oxygen consumption is presented below [1,2,3].

# RESULTS

## Experimental series A

The fetal and maternal flow rates, fetal-to-maternal flow ratio, arterial and venous O2, and venous-to-arterial O2 ratio measured at various fetal flow rates of dually perfused placenta (n=3). Data are presented as MEAN±S.E.M. (standard error of mean).

<table>
<thead>
<tr>
<th>Flow Rate (ml/min)</th>
<th>Fetal Flow Rate (ml/min)</th>
<th>Maternal Flow Rate (ml/min)</th>
<th>Fetal Flow Ratio</th>
<th>Fetal Arterial O2</th>
<th>Maternal Arterial O2</th>
<th>Venous Arterial O2 Ratio</th>
<th>Fetal Venous Arterial O2 Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.0</td>
<td>2.8 ± 0.7</td>
<td>0.8 ± 0.1</td>
<td>0.8 ± 0.1</td>
<td>98.5 ± 2.3</td>
<td>3.6 ± 0.3</td>
<td>0.2 ± 0.0</td>
<td>0.02 ± 0.0</td>
</tr>
<tr>
<td>5.0</td>
<td>3.6 ± 0.9</td>
<td>1.4 ± 0.2</td>
<td>2.5 ± 0.3</td>
<td>97.8 ± 2.1</td>
<td>3.4 ± 0.2</td>
<td>0.4 ± 0.0</td>
<td>0.03 ± 0.0</td>
</tr>
<tr>
<td>6.0</td>
<td>4.3 ± 1.0</td>
<td>2.2 ± 0.3</td>
<td>5.0 ± 0.4</td>
<td>96.5 ± 1.7</td>
<td>3.2 ± 0.1</td>
<td>0.8 ± 0.0</td>
<td>0.05 ± 0.0</td>
</tr>
<tr>
<td>8.0</td>
<td>5.6 ± 1.5</td>
<td>4.0 ± 0.5</td>
<td>2.5 ± 0.3</td>
<td>94.8 ± 2.1</td>
<td>2.8 ± 0.2</td>
<td>1.0 ± 0.0</td>
<td>0.10 ± 0.0</td>
</tr>
<tr>
<td>10.0</td>
<td>7.2 ± 2.1</td>
<td>6.0 ± 0.6</td>
<td>3.0 ± 0.4</td>
<td>93.5 ± 2.3</td>
<td>2.4 ± 0.2</td>
<td>1.2 ± 0.0</td>
<td>0.12 ± 0.0</td>
</tr>
<tr>
<td>12.0</td>
<td>8.9 ± 2.7</td>
<td>8.0 ± 0.8</td>
<td>4.0 ± 0.4</td>
<td>92.0 ± 2.2</td>
<td>2.0 ± 0.1</td>
<td>1.4 ± 0.0</td>
<td>0.14 ± 0.0</td>
</tr>
</tbody>
</table>

# DISCUSSION

In our experiments we increased feto-maternal and fetal flow rates. The increase of the fluid flow rate at flow ratio of 1 resulted in the decrease in the maternal and fetal transport fractions of antipyrine [5]. The comparison of fetal-to-maternal transfer of antipyrine [6] and FITC-conjugated Dextran in our experimental work (Figure 4) showed compatible data at the fetal/maternal flow ratio 0.6-0.9.

Decrease in placental oxygen consumption and increase in feto-maternal transfer of FITC dextran might be due to the fluid shunting between maternal and fetal compartments [6] and therefore inadequate oxygen exchange. The increase flow rates are associated with distention of the peripheral villous tree. The differences in the vascular composition of each cotyledon (SGI posterior # T14, Mumcu et al. 2018) might explain differences in the absolute feto-maternal transfer of FITC dextran with the increased fetal flow and flow rate.

The increase flow ratio is associated with fetal stromal edema (Kaufmann, 1985) – morphological changes, which have been suggested to result in decreased permeability.

# CONCLUSIONS

At the ex vivo placental perfusion, the optimal flow rate for oxygen transfer is 4.8 - 6 ml/min.

# ACKNOWLEDGEMENT

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# REFERENCES