



# PERFUSION OF HUMAN PLACENTA AS A MODEL OF VASCULAR RESEARCH

Maira Carrillo<sup>1</sup>, James Maher<sup>1</sup>, Gary Ventolini<sup>1</sup>, Ailena Mulkey<sup>2</sup>, Moss Hampton<sup>1</sup>

and Natalia Schlabritz-Loutsevitch<sup>1\*</sup>

<sup>1</sup>Dept. of Obstetrics and Gynecology, Texas Tech University Health Sciences Center, Odessa

<sup>2</sup>Clinical Research Institute, Odessa, TX

\*Natalia.schlabritz-lutsevitch@ttuhsc.edu



## Abstract

Pregnancy is the unique, short reproductive event with far reaching consequences for the individual, family and society. The placenta is the primary fetal organ of respiration, metabolism, nutrition and excretion. The early detection of placental dysfunction is critical for the fetal and maternal survival. Additionally the placenta is a highly vascular organ and has been used as a model for brain research and vascular responses.

The structure and function of the placenta differs between male and female fetuses, which makes it a perfect model to study gender-dependent vascular responses. There are indeed obvious gender differences in vascular responsiveness and vascular metabolism, which has been identified in other vascular beds. The technique of placental perfusion *in vitro* provides a unique opportunity to evaluate the physiological responses to the vascular active substances and estimate the feto-maternal drug transfer.

## Objectives

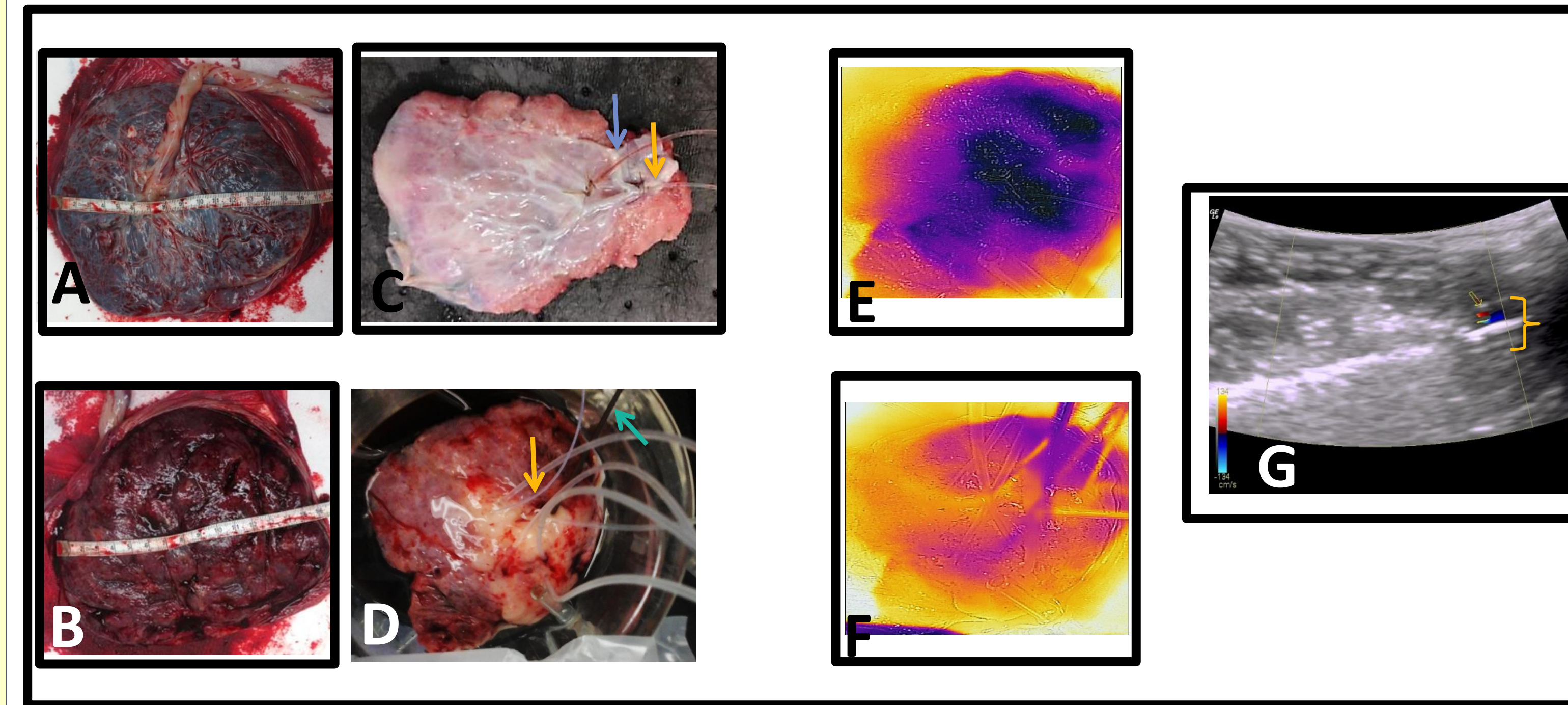
The objective is to establish the model of perfusion of human placenta *in-vitro* and to record indirectly placental vessel contractility.

## Materials and Methods

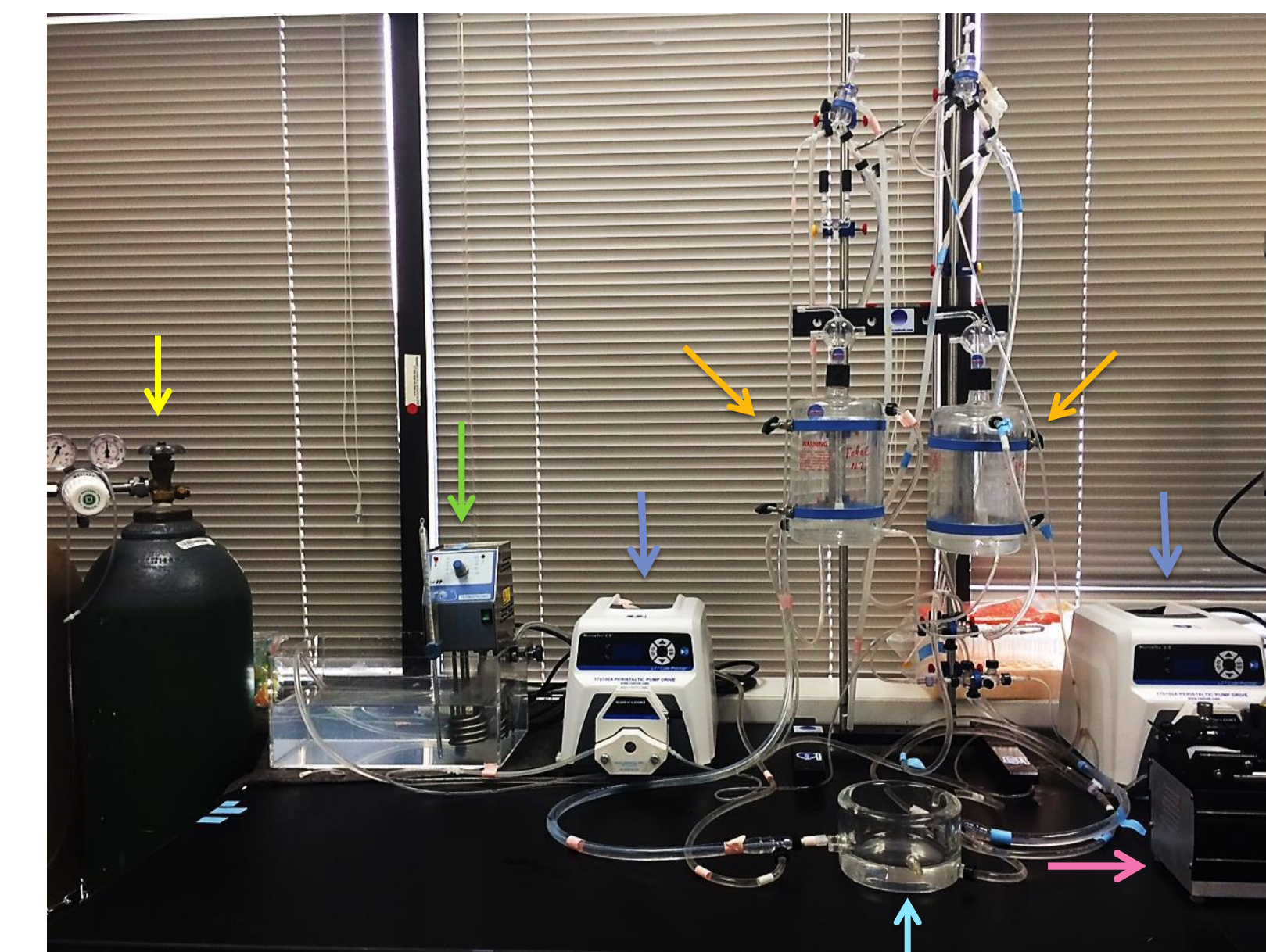
After obtaining the informed consent, placenta was received after non-complicated cesarean section delivery, the fetal artery was immediately cannulated, followed by the cannulation of fetal vein (Figure 1 A). The cannulation and flushing re-established the circulation in one of the intact cotyledons (Figure 1 B) at which time it is placed into the perfusion chamber (Figure 1 B). The re-established circulation is open circle fetal circulation (Figure 2). A basal fetal arterial hydrostatic pressure (FAHP) was recorded (Figure 3). After baseline is established, 3M KCl is added to induce vasoconstriction pressure is recorded using Lab Chart software (ADInstruments, U.S., Colorado Springs, Colorado). In addition to recording FAHP we also measure and record: temperature, pH, oxygen tension using Lab Chart. We also used the FLIR1 infrared technology to examine temperature of the sample which also provides indication that the placenta is still metabolically active.

## Results

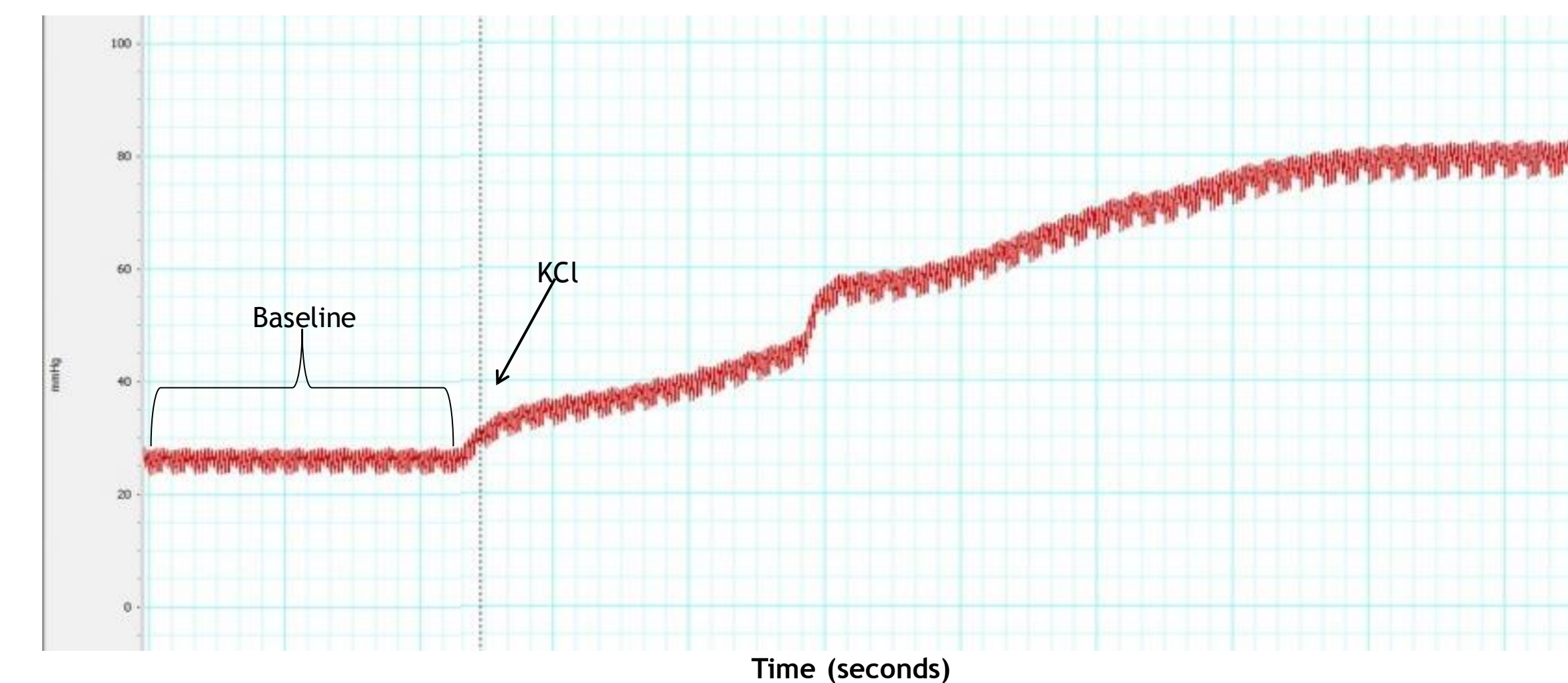
The mean FAHP was 35.3±5 mmHg, mean weight of the cotyledons was 44.0±4 g. The temperature in the perfused cotyledon was constant throughout the experiment.



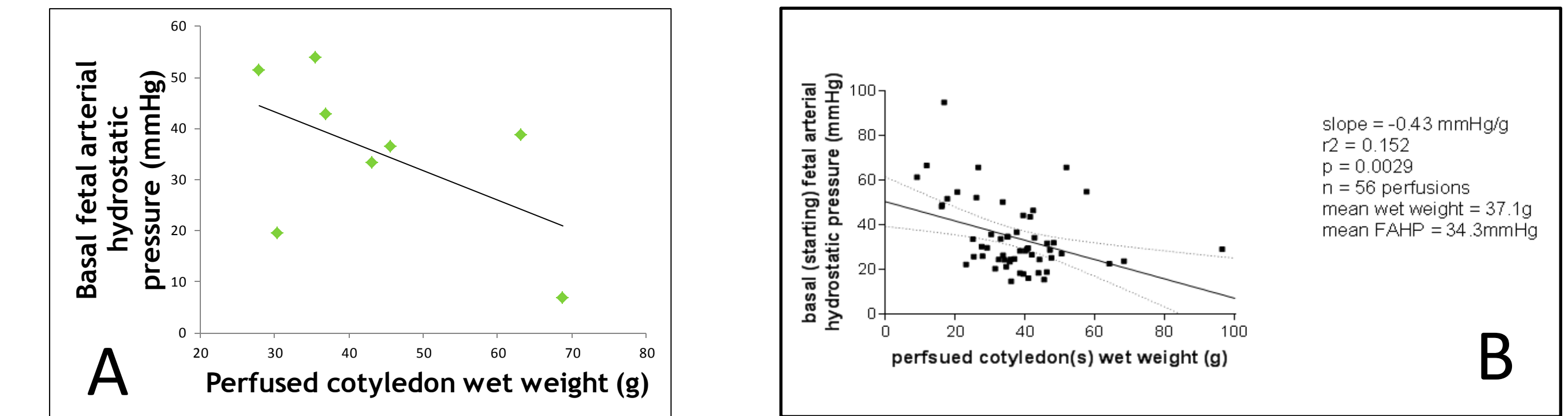
**Figure 1.** Cannulation of vessels and corresponding cotyledon. A and C) Chorionic plate (A) where vessels are cannulated (C) (blue and orange arrow) B and D) Decidual surface (B) (maternal side) after isolation of placental lobule and cotyledon perfusion (D). Orange arrows point to temperature sensor. Turquoise arrow shows oxygen sensor E and F) temperature map of the maternal side of placenta in the perfusion chamber just prior to (E) and after (F) perfusion. G) Doppler image of perfused placental cotyledon *in vitro*, yellow arrow shows perfusate flowing through a vessel.



**Figure 2.** Perfusion system. Orange arrows show fetal and maternal reservoirs. Blue arrows show fetal and maternal peristaltic pumps. Green arrow heated water bath. Turquoise arrow perfusion chamber. Pink arrow syringe pump. Yellow arrow: tank for gassing maternal and fetal perfusate.



**Figure 3.** Pressure recording of FAHP at baseline measurement and induction of vasoconstriction using 3M KCl.



**Figure 4.** Graphs showing Cotyledon weight vs FAHP ( Fetal arterial hydrostatic pressure) A) Data collected from our laboratory. B) Data collected from Laboratory of Dr. Brownbill (University of Manchester, UK)

**Table 1.** Patient, fetal and placental information.

Patient	Gestational age (weeks)	Maternal age (yrs)	BMI	fetal sex	Newborn's weight (g)	Cotyledon Wt. (g)	Fetal Pressure (mmHg)
1	39	25	28.21	female	3900	68.73	6.64
2	39	24	30.01	female	2830	30.4	19.46
3	29	34	25.31	male	3580	45.61	36.28
4	39	25	31.88	female	3330	63.2	38.67
5	39	23	24.20	female	2960	27.96	51.35
6	39	32	36.29	male	3480	43.2	33.23
7	39	24	25.76	male	3680	36.94	42.62
8	39	27	28.54	male	3330	35.6	53.78
9	39	23	36.15	male	3740	45.34	-
Mean±SEM	38	26	29.60±1		3386.25±112	43.96±13	35.25±5

## Conclusions

- We were able to establish placental perfusion *in vitro* in our laboratory, the only placental perfusion lab in West Texas.
- Our data is in line with those published by Dr. Brownbill.
- We were able to establish a baseline FAHP and subsequently induce vasoconstriction using 3M KCl. Induction of vasoconstriction shows that the placenta is viable and metabolically active.
- Placenta perfusion is an excellent tool for the study fetal gender specific responses.

## Acknowledgements

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