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BLOOD GAS DIFFERENCES BETWEEN THE UMBILICAL ARTERY AND VEIN IN TERM AND PRETERM NEWBORNS

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Background
Cord blood gas analysis reflects placental respiratory and metabolic function and is commonly used to assess fetal status at birth.

Aims
To identify the differences in blood gas parameters between the umbilical artery and vein at birth in term and preterm infants.

Design
Umbilical cord artery and vein samples were sampled from 225 term and 57 preterm infants. Term infants were classified in two groups AGA and SGA (adequate and small for gestational age respectively) according to birth weight percentile.

Results
The pH, pO_2, HCO_3^- and umbilical artery base excess (BE) were higher and pCO_2 was lower in the vein compared with the artery, in SGA compared with AGA term infants. In preterm infants, there were no significant differences in pH between the umbilical artery and vein, while the pO_2 was higher and pCO_2 was lower in the vein compared with the artery. BE and pCO_2 were higher and sodium (Na^+) was lower in the artery than in the vein in term compared with preterm infants. Glycaemia was lower in the artery than in the vein in all newborns and was related to venous glycaemia measured in the first hour of life (Table 1).

Conclusions
Significant differences in blood gas parameters between the umbilical artery and vein in both term and preterm newborns suggest the importance of the placental barrier and the need for accurate cord blood gas analysis interpretation at birth. Cord glycemic values appear to be a noninvasive tool for prediction of glycaemia during the first hour of life.

Key words: umbilical artery and vein, newborn, blood gas analysis, placenta, glycemia

Table 1. Cord blood biochemical parameters between the U_A and U_V in all groups.

Mean (SD)	Term AGA(N=194)			Term SGA(N=31)			Preterm(N=57)		
	Artery	Vein	P value	Artery	Vein	P value	Artery	Vein	P value
pH	7.22 (0.52)	7.33 (0.07)	0.003	7.27 (0.07)	7.35 (0.08)	0.000	7,28 (0.08)	7.29 (0.38)	0.804
pCO_2	53.0 (10.4)	43.0 (8.4)	0.000	50.3 (8.7)	40.2 (9.3)	0.000	53.1 (10.6)	42.8 (9.3)	0.000
pO_2	25.1 (8.6)	36.6 (12.1)	0.000	23.9 (4.4)	36.7 (9.5)	0.000	22.5 (5.7)	32.4 (8.4)	0.000
BE	-3.7 (2.9)	-3.3 (2.5)	0.003	-4.3 (2.5)	-3.6 (2.3)	0.055	-2.5 (2.6)	-3.0 (2.6)	0.081
Na^+	133.6 (5.7)	135.4 (5.2)	0.000	134.7 (4.6)	136.6 (3.8)	0.035	135.7 (3.0)	135.4 (2.9)	0.326
Ca^{++}	1.3 (0.7)	1.3 (0.1)	0.000	1.2 (0.2)	1.3 (0.1)	0.120	1.4 (0.1)	1.4 (0.1)	0.117
K^+	5.8 (1.4)	5.7 (1.6)	0.661	6.2 (1.5)	6.1 (1.4)	0.646	4.9 (0.9)	4.8 (1.3)	0.484
Ht	43.1 (8.8)	45.2 (7.7)	0.002	42.6 (5.9)	43.0 (6.2)	0.734	42.4 (5.7)	43.8 (4.7)	0.009
Glucose	66 (14)	77 (18)	0.000	63 (12)	71 (14)	0.000	68 (21)	76 (21)	0.000
HCO3-	23.9 (2.6)	22.1 (2.5)	0.000	22.8 (1.9)	21.4 (2.1)	0.001	24.5 (2.6)	22.4 (3.0)	0.000

METABOLOMIC PROFILE OF PRETERM BREAST MILK OVER THE TIME: THE EVIDENCE OF PERSONALIZED NUTRITION

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Background and aim
Human milk is the best nourishment for the healthy growth and development of infants. The composition of milk changes over time, and the preterm milk is pretty different from the full term milk. Understanding how human milk changes during lactation is crucial to guarantee the nutritional requirements of the newborn, especially for premature infants. The aim of this study is to test the hypothesis that milk metabolic profile from mothers delivering prematurely changes over the first three weeks of life and at term of gestation never resembles milk from mothers delivering at term.

Methods and results
NMR spectroscopy was used to analyze metabolome pattern of 30 human milk samples. 12 term milk samples, collected

once within 4 to 7 days after birth, were compared to 18 preterm milk samples, collected weekly after delivery until the 4th week after birth. Principal Component Analysis (PCA) showed two distinct metabolites groups, one represented by the 18 preterm milk samples, and the other by the term milk samples (Figure 1). Metabolite profiling identified that lactose and oligosaccharides levels were significantly more represented in preterm than in milk term samples.

Conclusions
Preterm milk metabolome pattern changes during the first 4 weeks after birth, but at the end of the third week still does not resemble the term milk pattern. The specific changes in mother milk metabolic profile according to their offspring clearly reflect the different nutritional requirement of each preterm infants. This knowledge is crucial to move from standardized nutritional protocols to a tailored, individualized nutrition.

Key words: preterm newborn, breast milk, metabolomics.

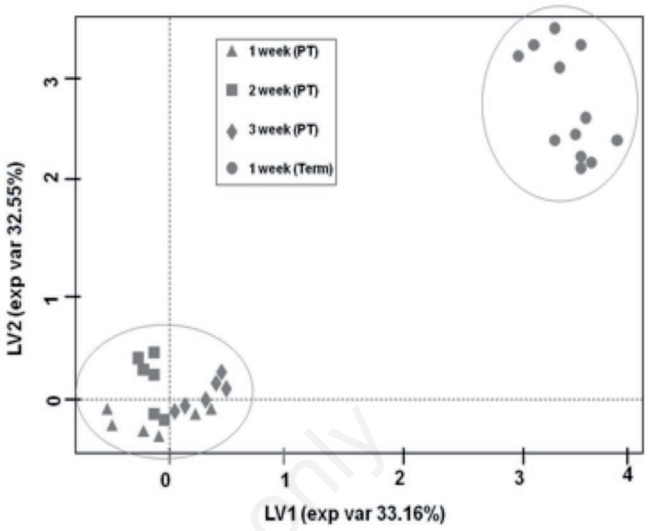

Figure 1.

EARLY PREDICTION OF FUNCTIONAL RESPIRATORY OUTCOME OF IUGR FETUSES

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Background
Intrauterine growth restriction (IUGR) is associated with poor respiratoty outcome at birth influencing growth and neurocognitive outcome in later life. Fetal Magnetic Resonance Imaging (f-MRI) provides informations about the development of individual organs, such as the lung. The aim of our study is to evaluate if the f-MRI is useful to predict their perinatal respiratory outcome in IUGR fetuses.

Methods
Twenty pregnancies undergoing f-MRI at "S.Maria alle Scotte" Hospital, in Siena, were recruited: 10 pregnancies had IUGR foetuses and 10 coupled for fetal gestational age at the time of f-MRI served as control population. The ultrasound evaluation of the fetal weight (EFW) and babies' information at birth were collected. The MRI protocol consist of T2 weighted images. 6ROI (Region of Interest) were placed as follow: 2 on the lung, 2 on the liver and 2 on the amniotic fluid (Figure 1).The signal intensities(SI) of each ROI were measured. A ratio comparing the SI of the lung with structures at a comparable depth used as a reference was introduced.SI lung to liver ratio (SI lung/liver) and SI lung to amniotic fluid (SI lung/amniotic fluid) ratio were related to fetal anthropometric measures and compared between IUGR and control group. In order to compare the fetuses that recover their growth from those who born small for gestational age (SGA), the newborn at birth were also divided in AGA and SGA. All the results were studied in relation to the subsequent perinatal respiratory outcome.

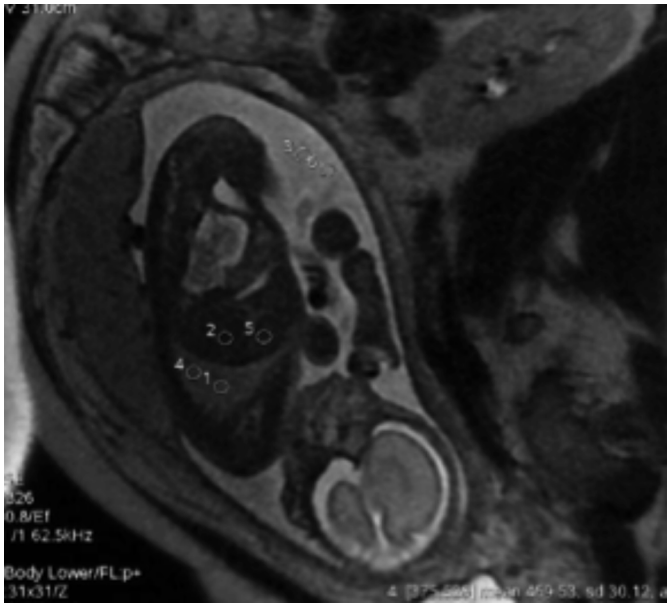

Figure 1. Coronal SSFSE T2-weighted image where 6 ROI were placed.

Results
SI lung/liver was linearly related to gestational age at the time of f-MRI (Rho=0.858; P<0.001) and to EFW (Rho=0.794; P<0.001). SI lung/amniotic fluid was significantly higher in the IUGR group than in the control group (respectively: 0.80±0.06 and 0.65±0.03; P=0.043). Looking at the respira-

tory outcome, the IUGR population showed a higher amount of days of oxygen needs (IUGR: 12.25±8.13 *vs* Control: 1.9±1.01; P=0.005). In contrast, among the IUGR fetuses, lower values of SI lung/amniotic fluid were found in the SGA population than in the AGA group (respectively: 0.63±0.07 and 0.9±0.06; P=0.036). The days of oxygen supply were higher in the SGA newborns than in the (adequate for gestational age) AGA group (30.66±18.52 and 1.2±0.96; P=0.028).

Conclusions
SI lung/liver increases with fetal lung maturation and correlates to estimate intrauterine fetal growth. SI lung/amniotic fluid is able to identify the IUGR newborns that can recover their growth from those that will be born SGA. The f-MRI represents a promising frontier for the IUGR fetus outcome prediction, contributing to ameliorate the perinatal management of IUGR pregnancies.

Key words: IUGR, fetus, respiratory outcome, fMRI

ENDOMETRIAL RECEPTIVITY: EXPRESSION PROFILE OF CANDIDATE GENES IN ENDOMETRIOSIS

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The embryo implantation is a very complex process in which the endometrium plays a pivotal role by secreting in uterine fluid several factors that directly affect blastocyst development and/or by modulating the expression of key epithelial adhesion molecules. Accordingly, many pathologies affecting endometrial functionality should alter implantation process and, as a consequence, cause infertility. Among others, endometriosis has a negative impact on embryo implantation and pregnancy rate and, for these reasons, it is considered as one of the major causes of female infertility. Really, despite the great progress achieved by assisted reproductive techniques, implantation represents one of the most crucial stage. Moreover, several evidences suggest that controlled ovarian hyperstimulation may alters endometrial physiology thus impairing receptivity, with possible negative effects on embryo implantation. In this study, we analyzed the expression profile of selected genes involved in endometrial receptivity, both in tissue biopsies and in primary human endometrial stromal cells (HESC) isolated from eutopic and healthy endometrium, untreated or treated with FSH in combination with LH or hCG, in order to reproduce hormonal hyperstimulation conditions. We hereby demonstrated by qRT-PCR, by using a pre-spotted plate containing 24 genes reported to be involved in the implantation process, that there is a different gene expression profile in tissues from healthy and eutopic endometrium. Moreover, our results show how the in vitro hormonal stimulation may affect this specific fingerprinting. This approach allowed us to identify key genes whose expression is significantly modulated in eutopic compared to healthy HESC, also in response to hormonal hyperstimulation. This study, if replicated in a larger population, might contribute in understanding the impact of the ovarian hyperstimulation protocols used in assisted reproductive technology (ART) cycles.

Key words: Endometrial receptivity, embryo implantation, endometriosis, controlled ovarian hyperstimulation, endometrium, endometrial stromal cell.

ENVIRONMENTAL CONTAMINANTS INTERFERENCE ON PLACENTAL GLUCOSE HOMEOSTASIS AND FETAL DEVELOPMENT

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Glucose is one of the main nutrients for fetal development. Nevertheless, the ability of gluconeogenesis by the fetus has never been reported, therefore the fetal glucose homeostasis depends on the ability of the placenta to carry out glucose uptake from the maternal blood and to transport the glucose to fetal tissues by means of specific transport molecules, named GLUTs.
Different conditions can contribute to an imbalance in fetal glucose homeostasis, including: incorrect mother feeding, maternal obesity, maternal type II diabetes and/or pregnancy complications such as intrauterine growth restriction and gestational diabetes. These conditions can affect the normal development of the fetus. It is now known that environmental contaminants are able to impair placental glucose homeostasis compromising fetal development. These substances include man made chemicals with estrogen-like behaviour referred as to Endocrine Disrupting Chemicals (EDCs). However, in which way these substances are able to interfere with glucose uptake and how this interference is reflected on an incorrect fetal development has to be elucidated.
At this end, we examined the effect of two representative EDCs: Bisphenol A (BPA) and para-nonylphenol (*p*-NP), both chemicals widely distributed in many daily used products such as plastic materials, metal cans for food consumption, cosmetics and resins. In particular, the study aimed to clarify the effect of these substances on human placenta. The study was performed on HTR8-SV/neo cells, an *in vitro* model of human trophoblast. The cells were cultured with DMEM medium at different glucose concentrations (2.5; 5 and

25mM). Furthermore, for each glucose concentration, the HTR-8 cells were treated with BPA or *p*-NP and then tested for glucose uptake and GLUTs' levels of expression. The results showed that both the EDCs affected glucose transport and uptake thus proving the interference of estrogen-like environmental contaminants on maternal-fetal glucose transport and possibly on a correct fetal development.

Key words: EDCs; Bisphenol A; para-nonylphenol; placental glucose transporters.

STUDY OF NANOPARTICLE FORMATION IN A NANOPOROUS STRUCTURE AND APPLICATIONS

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The search for new materials and for structuring them at a microscopic and nanoscopic level has received an unbelievable growth in the last decade. One of the most promising method is given by the light – matter interaction, that can produce several important phenomena, as, for example, production of 2D or 3D nanostructures, optical traps and manipulation of nanoparticles, synthesis of quantum dots in nanomatrices.
We present a project, proposed in collaboration with ITMO at Sant Petersburgh (Russia), finalized to produce aggregates of alkali-nanoparticles from Al_2O_3 coated porous silica in an ultra-high vacuum chamber, by loading it with alkali atoms, specifically Rubidium. The russian team has provided the transparent sample, via deposition of a thin film (300 nm) of porous alumina on a sapphire substrate. Porous alumina has a huge internal surface due to the pattern of nanopores that have been chemically digged into it. The sample has been lodged on a mechanical translational/rotational stage inside a Ultra – High – Vacuum (UHV) chamber. The alkali loading is given by a Rubidium dispenser, that generates a sort of atomic beam controlled in density by the heating current intensity crossing it. The presence of Rubidium in the chamber is detected through a direct spectroscopy measurement of absorbance with a diode laser set on resonance frequency looking at a rubidium reference cell. The same diode provides a transmission signal through the sample as well. The accumulation of Rubidium inside the nanopores is checked via Light Induced Atom Desorption, by shining an UV diode laser beam on the coated sample surface. The signal is very small and more sensitive detection methods have been installed. The experimental setup will be completed in the future by an X – Ray Photoelectron Spectroscopy (XPS) system, in order to study the formation of aggregates in the sample.

Key words: Nanoparticle, Laser Spectroscopy, Alkali atoms, Photonics, Plasmonics.