

Fisiologia adaptativa do mecanismo de transição feto- neonatal

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FMVZ-USP



LIAPP

Laboratório de Inseminação Artificial, Perinatologia e Patologia da Reprodução



“

The transition from a fetus to a newborn is the most complex physiologic adaptation that occurs in human experience.

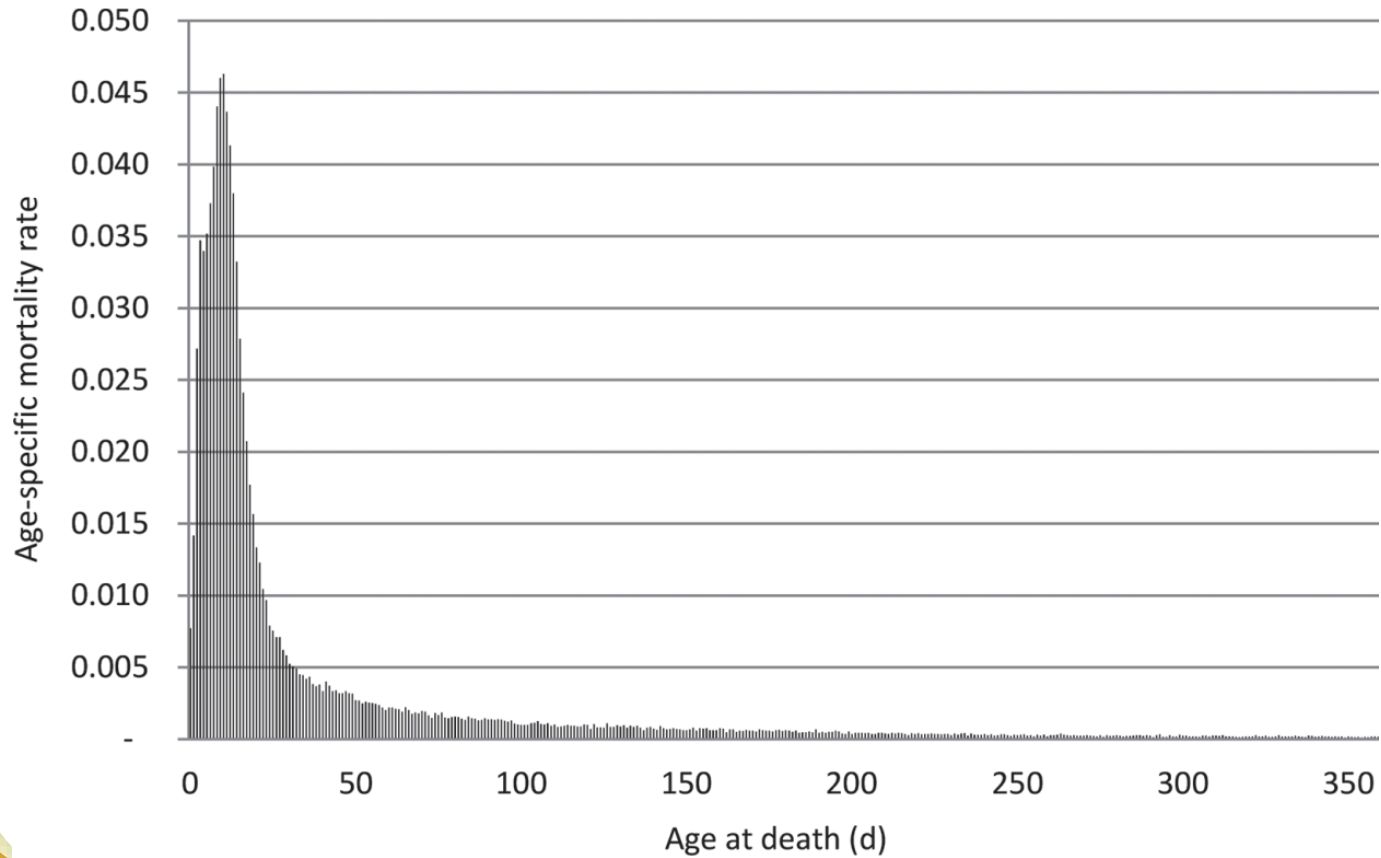
Dr. Alan H. Jobe (Cincinnati Children's Hospital – EUA)

Transição feto-neonatal

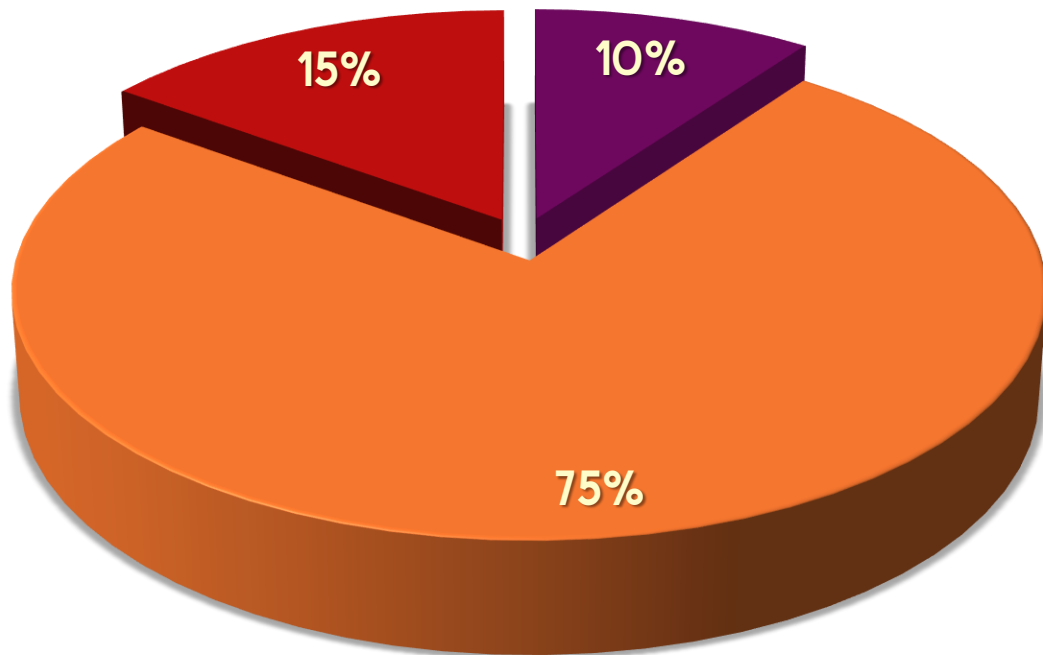


- Rápida
- Multissistêmica





Mortalidade neonatal em bezerros



- natimorto
- período inicial (48hs)
- período tardio



90%

dos bezerros que morrem no período perinatal estavam vivos
ao início do parto

Mee (2008)

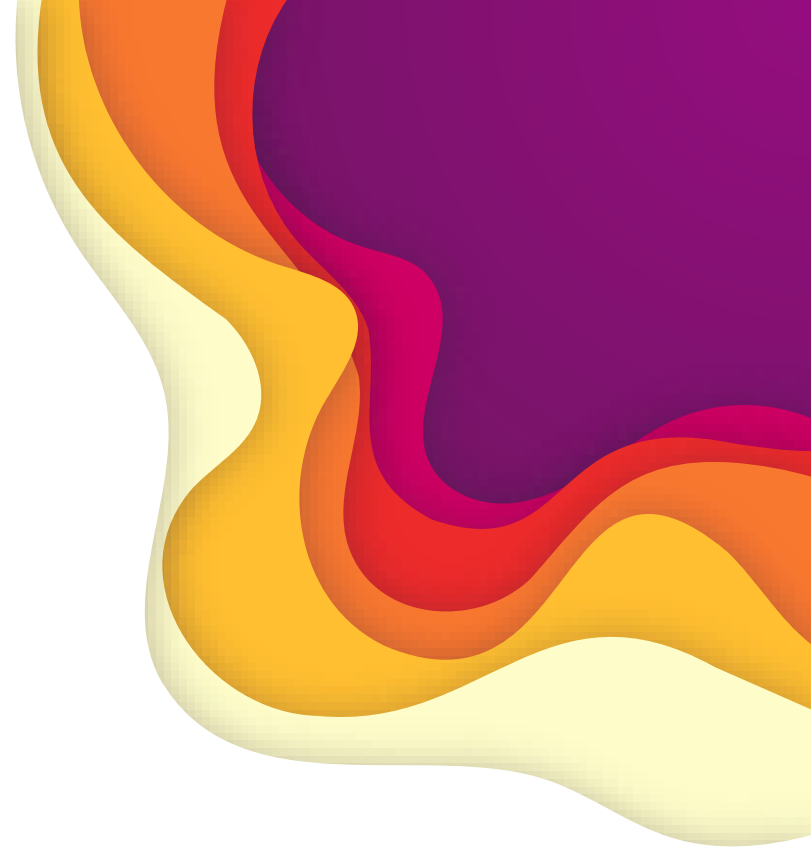
Adaptações imediatas necessárias

Adaptações
endócrinas

Adaptações
metabólicas

Adaptação
respiratória

Adaptação
cardiovascular



1. Adaptações endócrinas

Síntese e ação hormonal





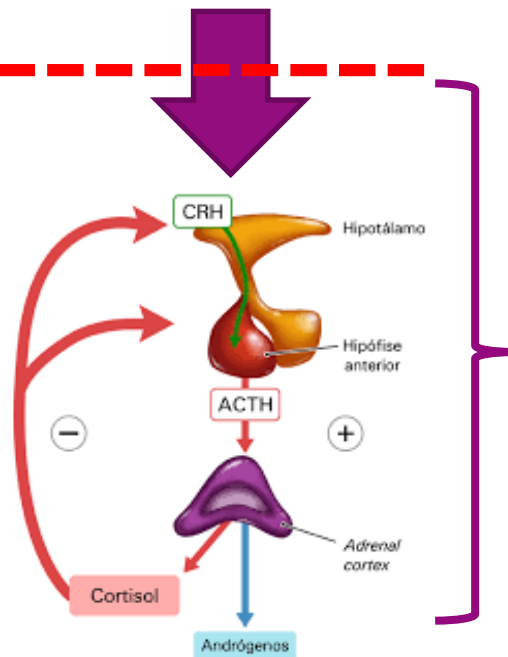
Cortisol

Maturação final dos fetos

Corticosteróides
maternos

PLACENTA

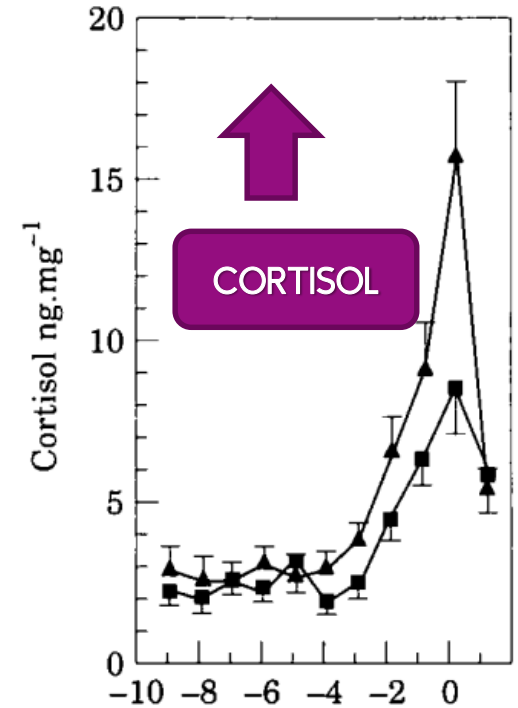
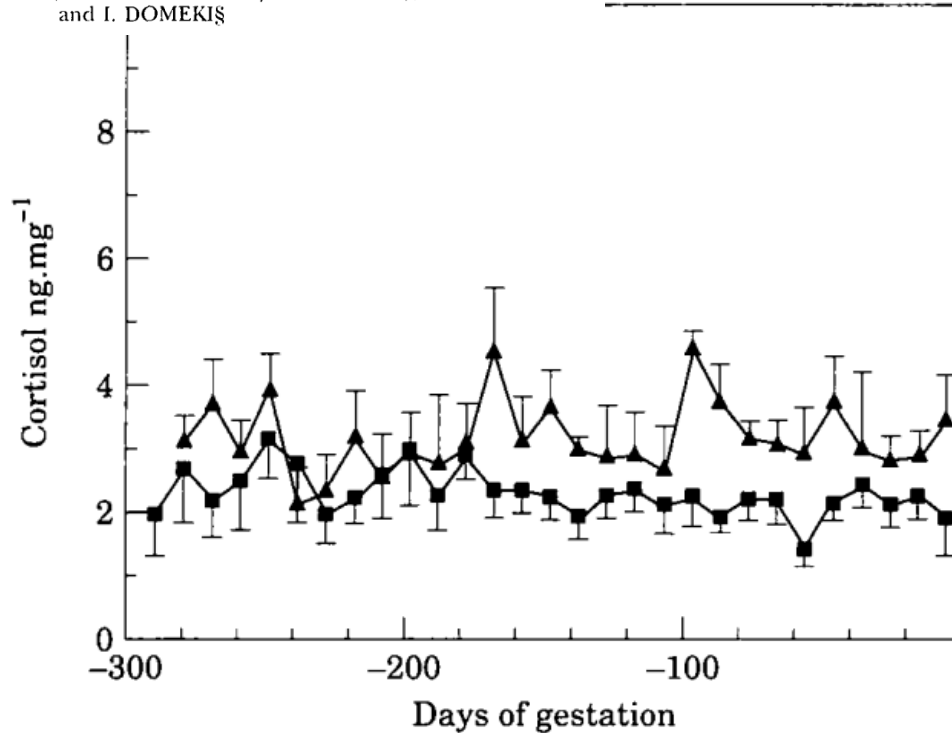
FETO (imaturidade
adrenal)

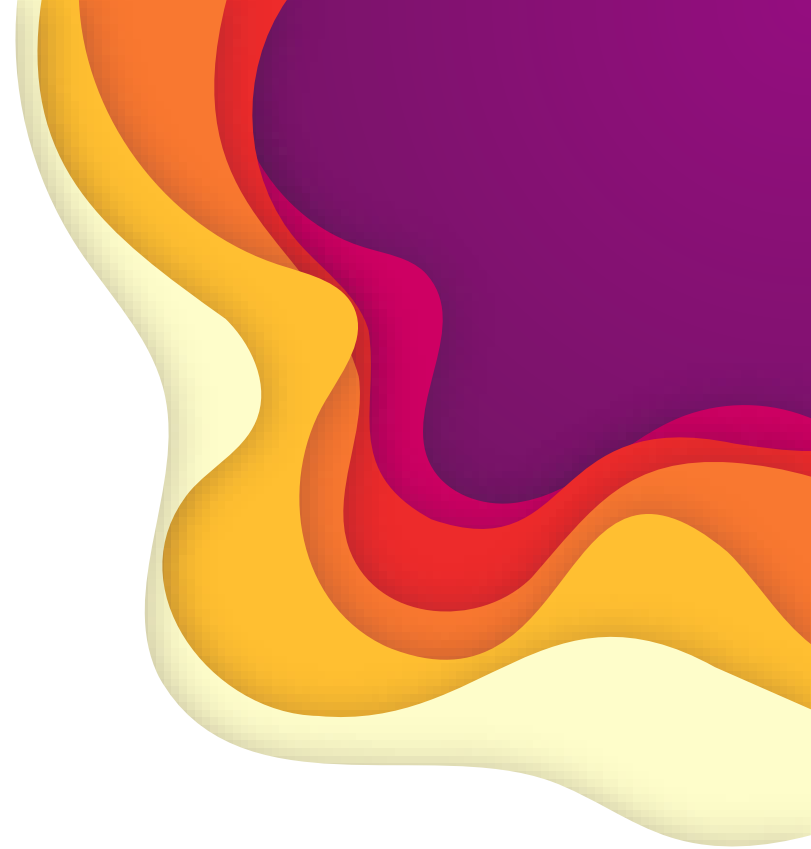


Início da
maturação fetal

PERIPHERAL CORTISOL LEVELS THROUGHOUT GESTATION IN THE COW: EFFECT OF STAGE OF GESTATION AND FOETAL NUMBER

O. V. PATEL*, T. TAKAHASHI†, N. TAKENOUCHI‡, M. HIRAKO†, N. SASAKI* and I. DOMEKI§

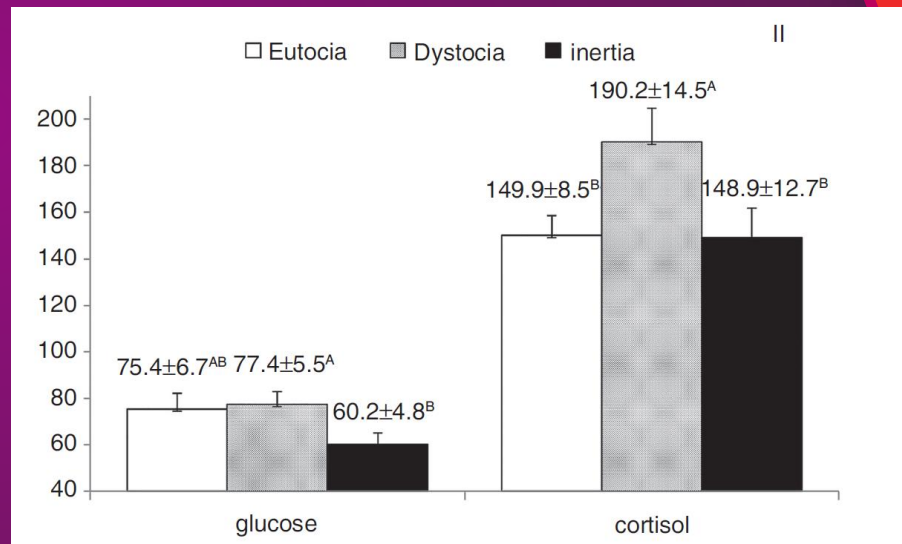
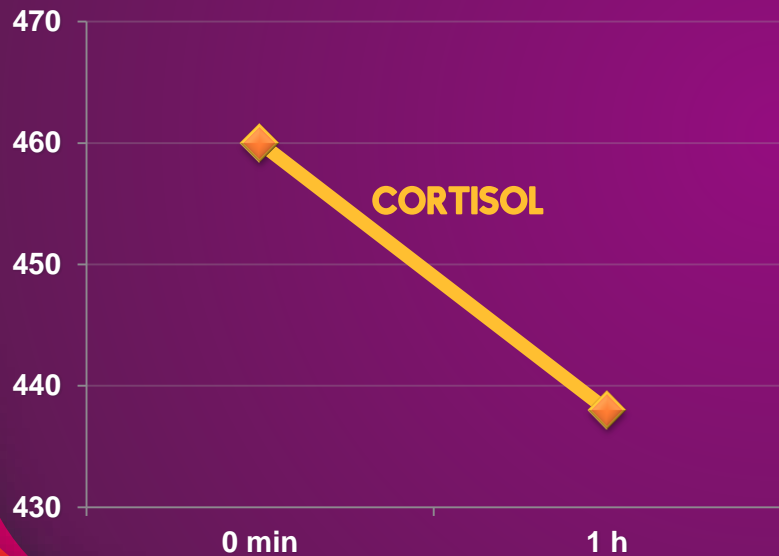




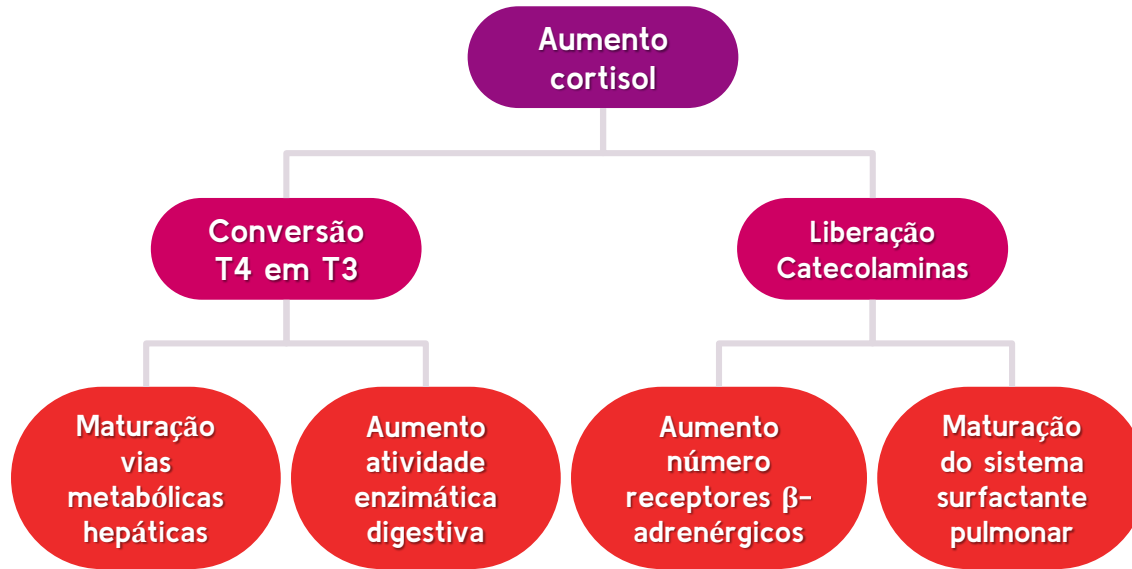
Paper

Association between birth conditions and glucose and cortisol profiles of periparturient dairy cows and neonatal calves

C. I. Vannucchi, J. A. Rodrigues, L. C. G. Silva, C. F. Lúcio, G. A. L. Veiga, P. V. Furtado, C. A. Oliveira, M. Nichi



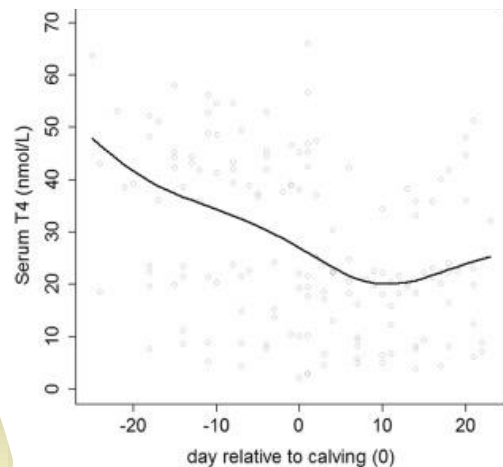
Vias endócrinas ativadas





Thyroid hormone profiles and TSH evaluation during early pregnancy and the transition period in dairy cows

L. Steinhoff^a, K. Jung^b, M.M. Meyerholz^c, J. Heidekorn-Dettmer^a, M. Hoedemaker^a, M. Schmicke^{a,*}



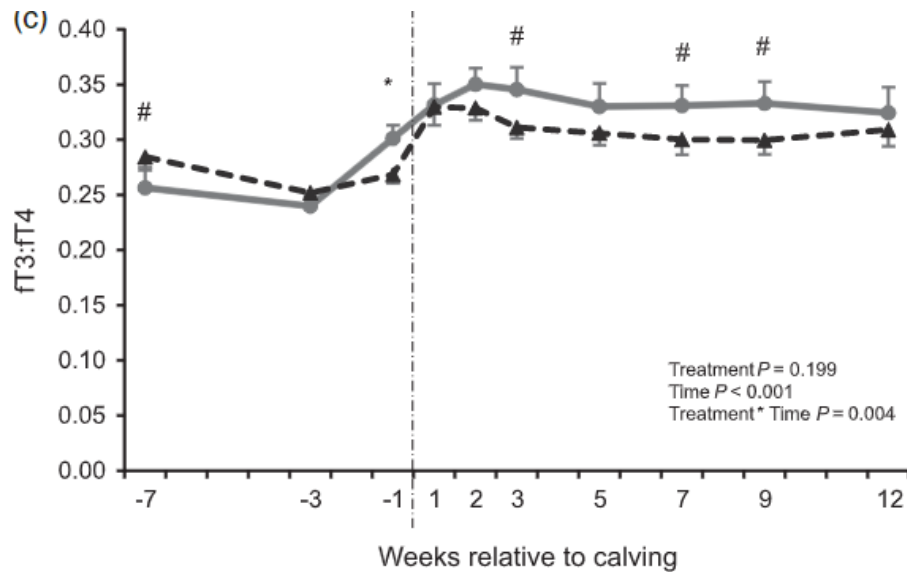
T4



T3

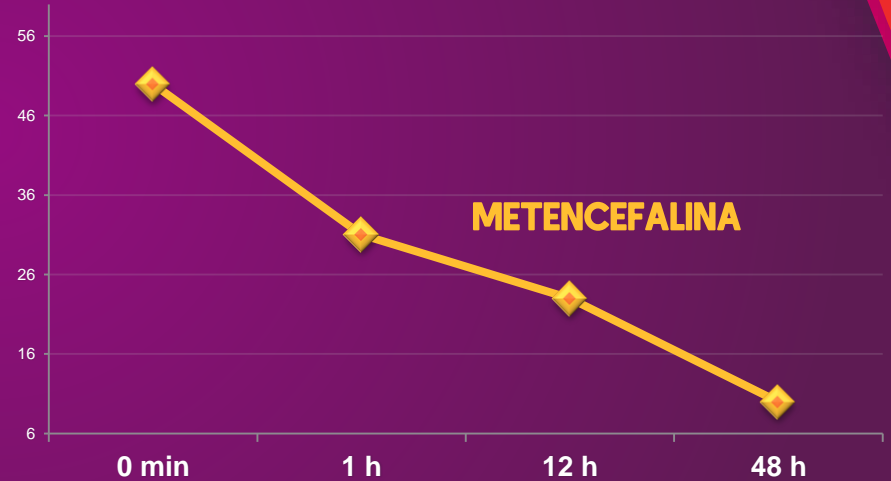
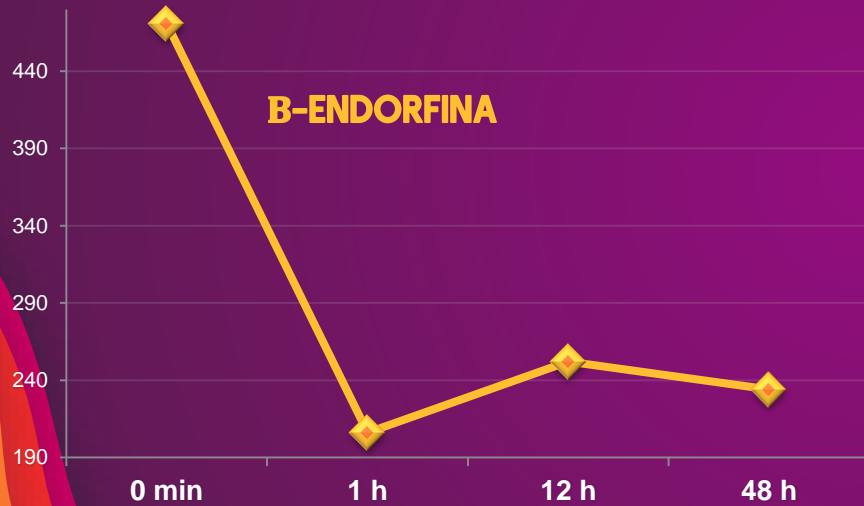
Comparison of performance and metabolism from late pregnancy to early lactation in dairy cows with elevated v. normal body condition at dry-off

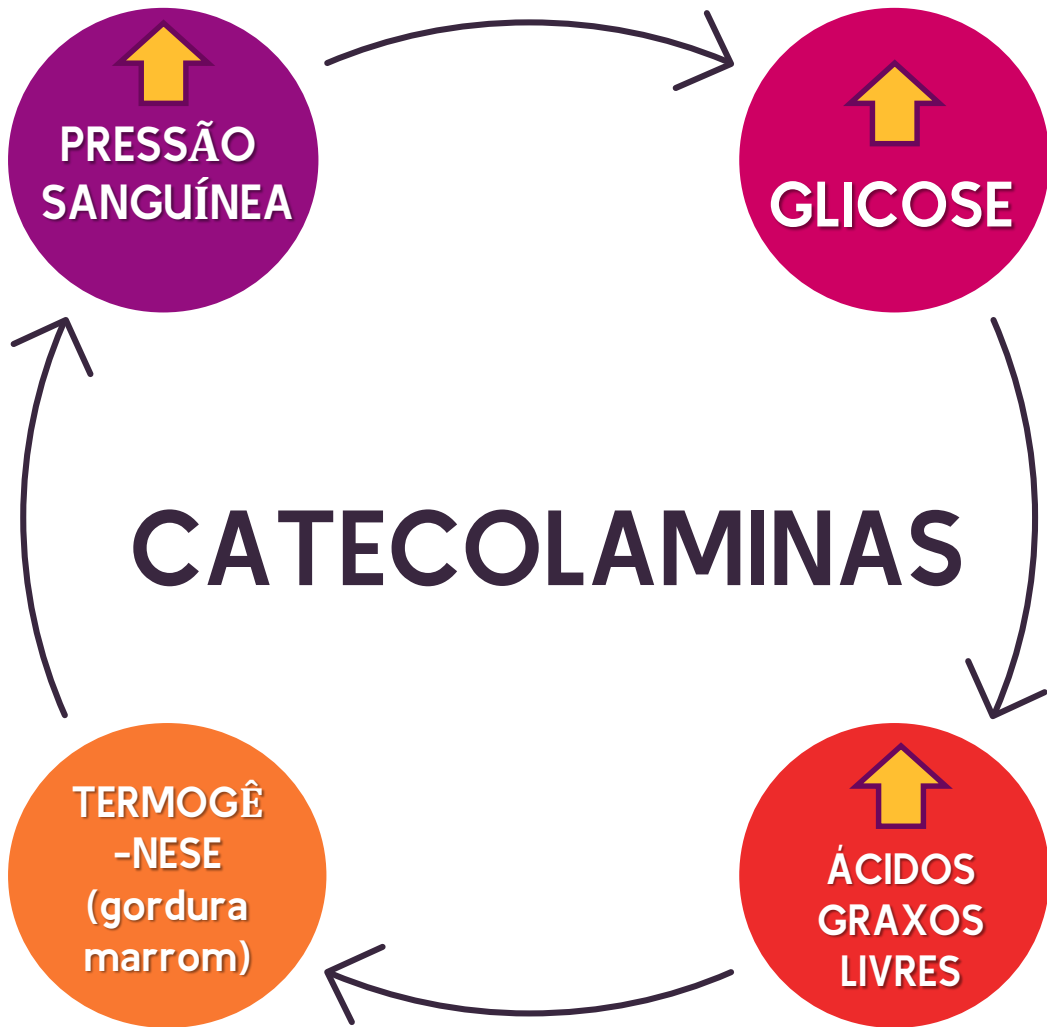
K. Schuh^{1,2}, H. Sadri^{3,1†}, S. Häussler¹, L. A. Webb¹, C. Urh¹, M. Wagner⁴, C. Koch⁵, J. Frahm⁶, S. Dänicke⁶, G. Dusel² and H. Sauerwein¹



β -Endorphin and met-enkephalin in plasma of cattle during pregnancy, parturition and the neonatal period

J. E. Aurich, I. Dobrinski, H.-O. Hoppen* and E. Grunert





2. Adaptações metabólicas

Metabolismo energético



Ambiente fetal intra-uterino

Substrato energético materno

Aumento atividade insulinêmica e redução do glucagon

**Reduzida gliconeogênese
Aumento glicogênese hepática**

Aumento do tecido adiposo



Transição feto-neonatal

1

**Suprimento energético
cessa**

Redução níveis glicose e ácidos
graxos circulantes

2

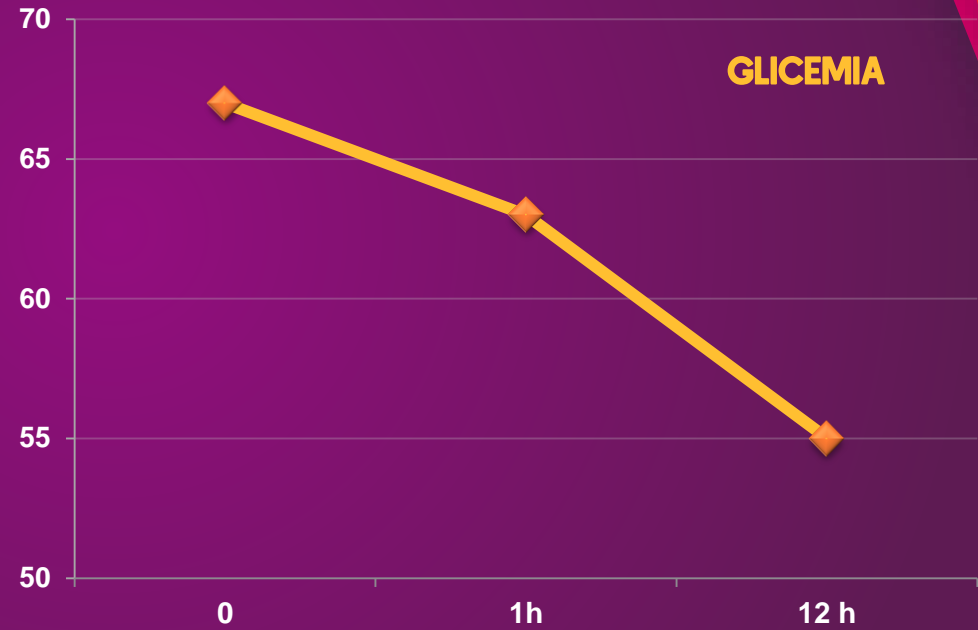
**Queda insulina e
aumento glucagon**

Ativação mecanismos
homeostase glicêmica

3

**Ativação do
mecanismo estresse**

Cortisol e catecolaminas



Vannucchi et al. (2018)

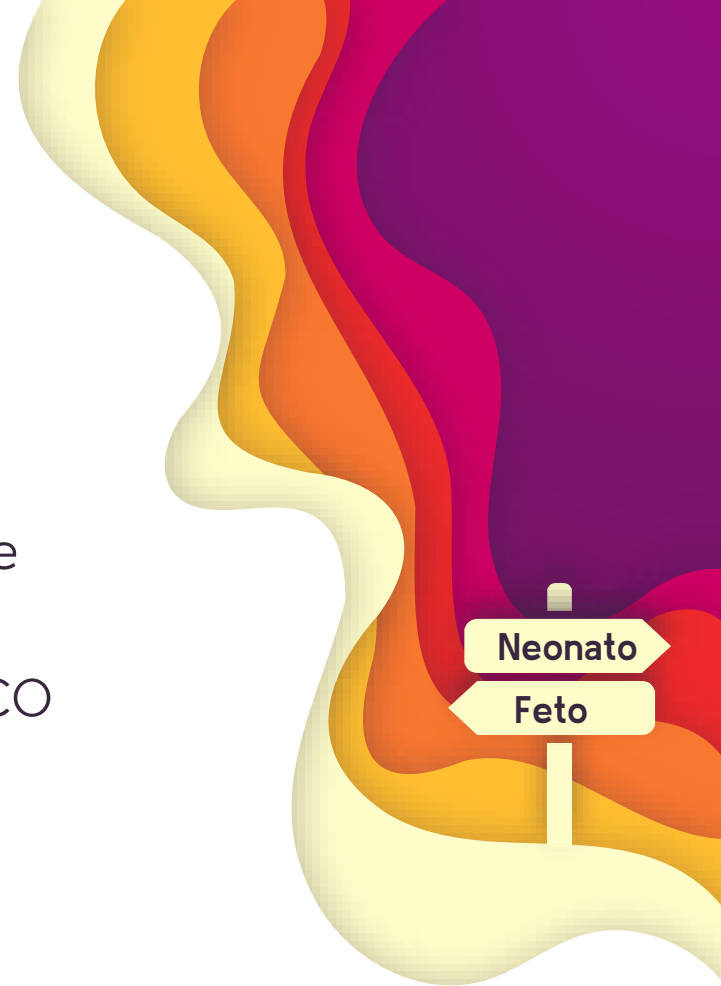
Termorregulação

Fetal

- Temperatura fetal é $\pm 0,5^{\circ}\text{C}$ superior à materna
- Feto produz calor por metabolismo

Neonato

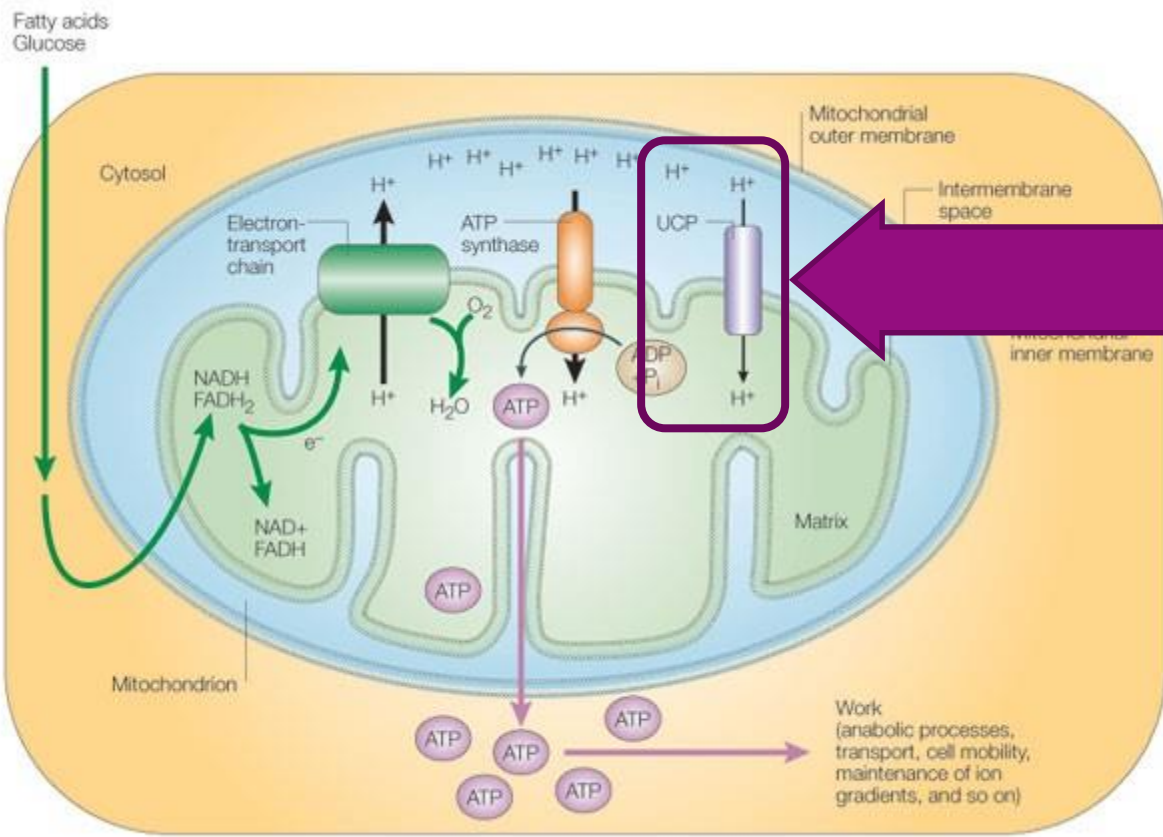
- Estímulo térmico (frio) na superfície corpórea – ESTRESSE TÉRMICO
- Estímulo do mecanismo simpático





Ativação da termogênese

Metabolismo da gordura marrom

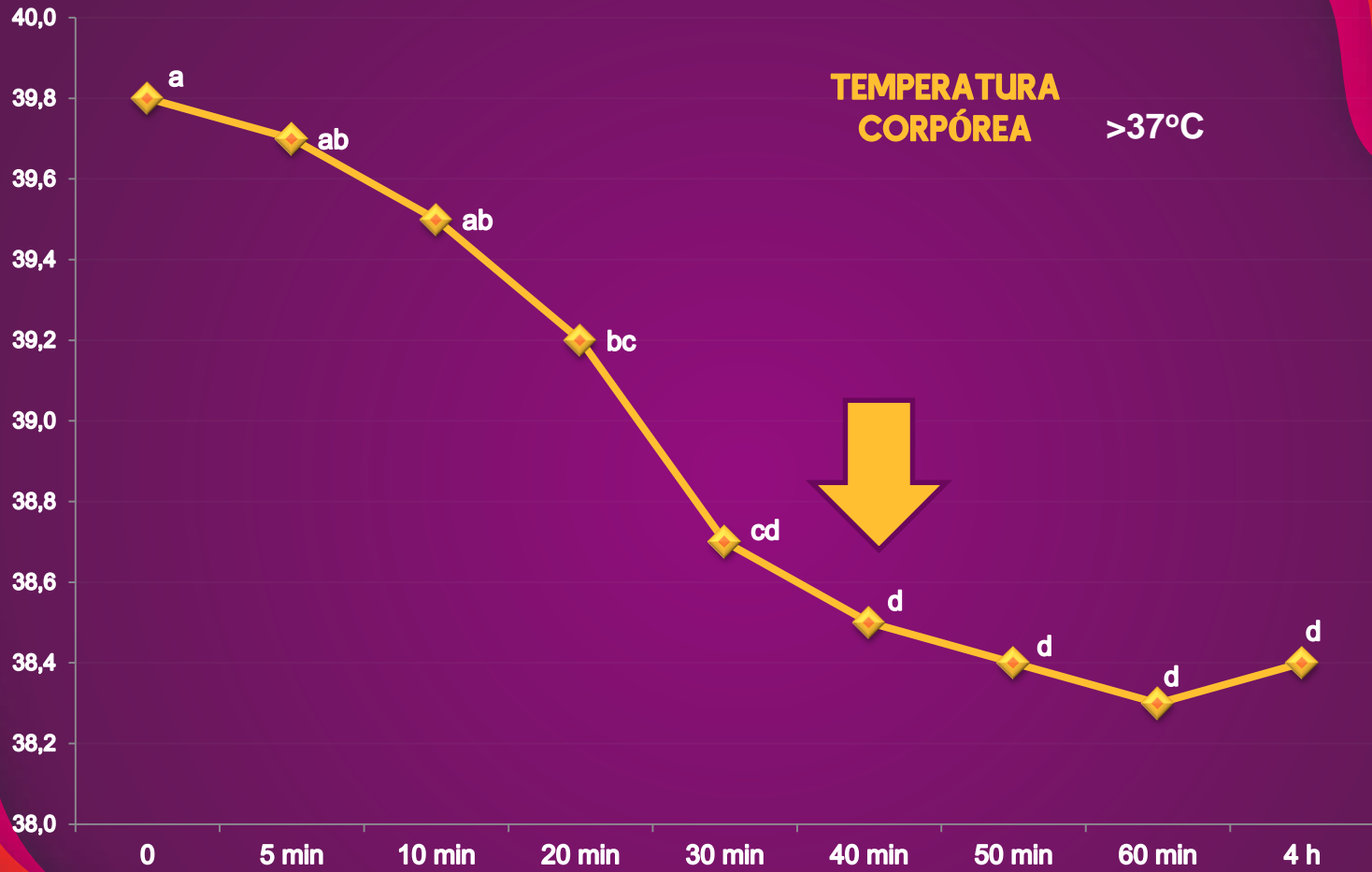


Nature Reviews | Molecular Cell Biology

Ao final da gestação

- Conversão local de T4 em T3
- Aumento cortisol fetal

Produção de calor por metabolismo oxidativo da gordura marrom

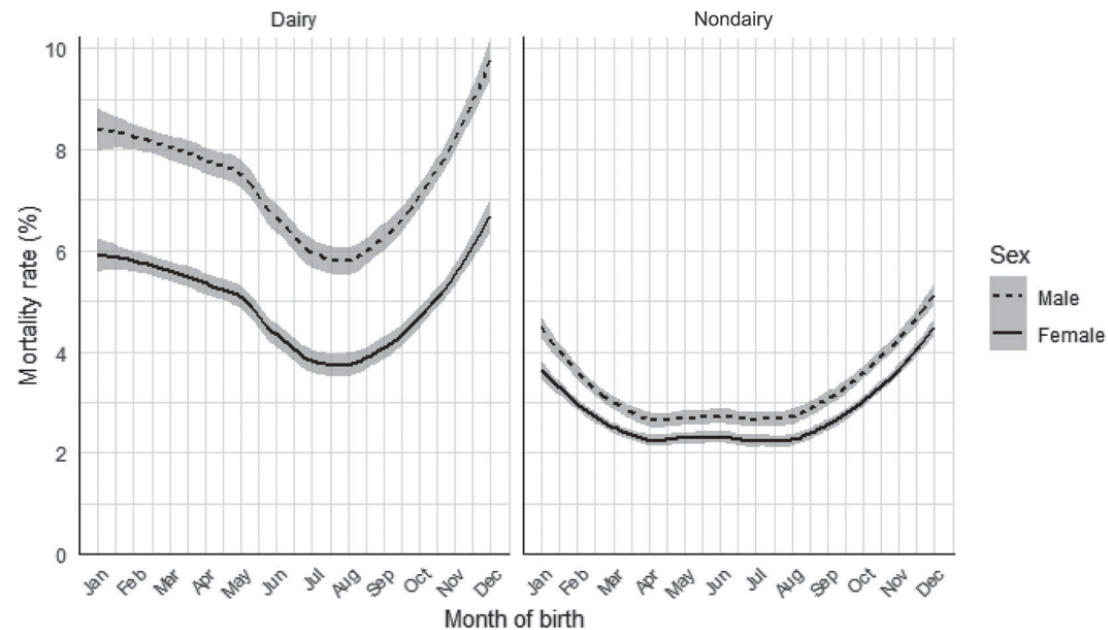


Quantitative analysis of calf mortality in Great Britain

Robert M. Hyde,^{1*} Martin J. Green,¹ Virginia E. Sherwin,¹ Chris Hudson,¹ Jenny Gibbons,² Tom Forshaw,² Mary Vickers,² and Peter M. Down¹

¹School of Veterinary Medicine and Science, University of Nottingham, Sutton Bonington Campus, Leicestershire, United Kingdom

²Agriculture and Horticulture Development Board, Stoneleigh, Kenilworth, United Kingdom, CV8 2TL



- Relação entre temperatura ambiental e mortalidade neonatal é maior quando $<4,8^{\circ}\text{C}$
- Mortalidade neonatal aumenta 0,2% a cada queda de 1°C , mas somente quando a temperatura ambiental é $<9,6^{\circ}\text{C}$



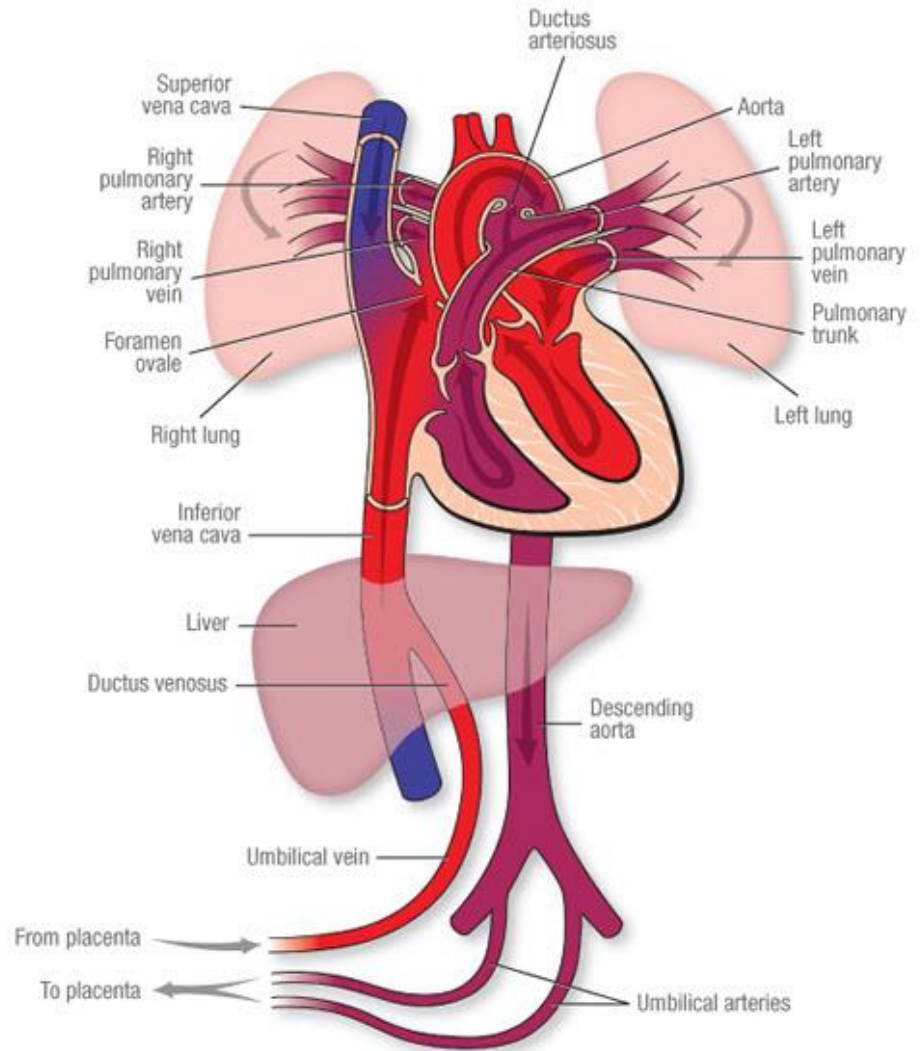
3. Adaptações cardiovasculares

Sistema cardiovascular sofre grandes
mudanças!



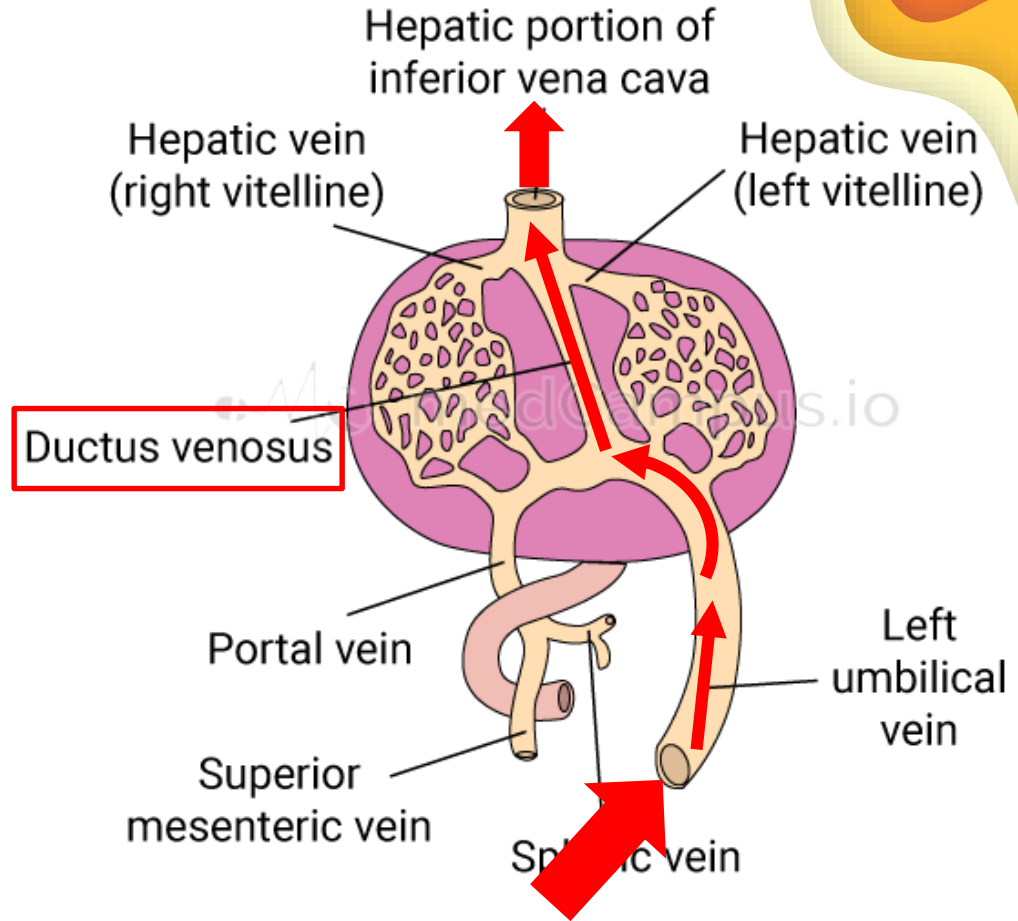
Circulação fetal

- Fluxo placentário de baixa resistência
- Ducto venoso
- Foramen oval
- Ducto arterioso



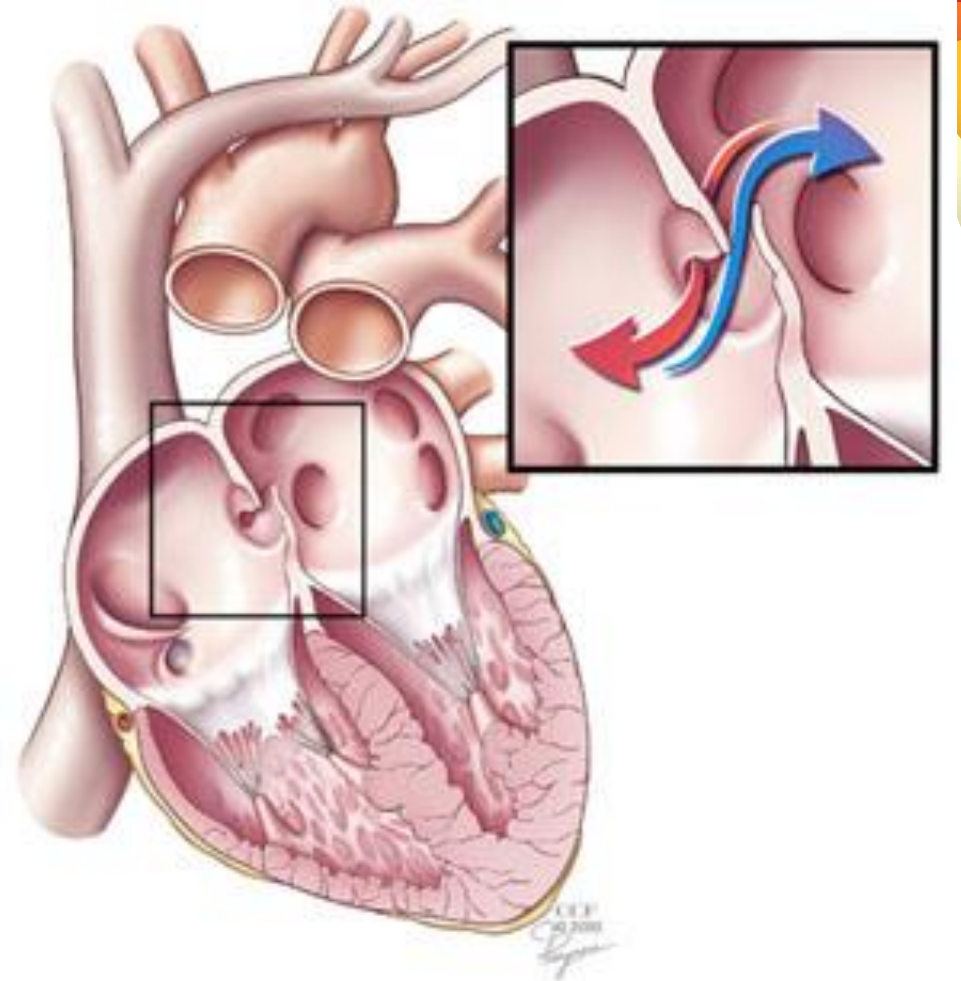
Circulação fetal

- Ducto venoso – união da veia umbilical com a veia cava



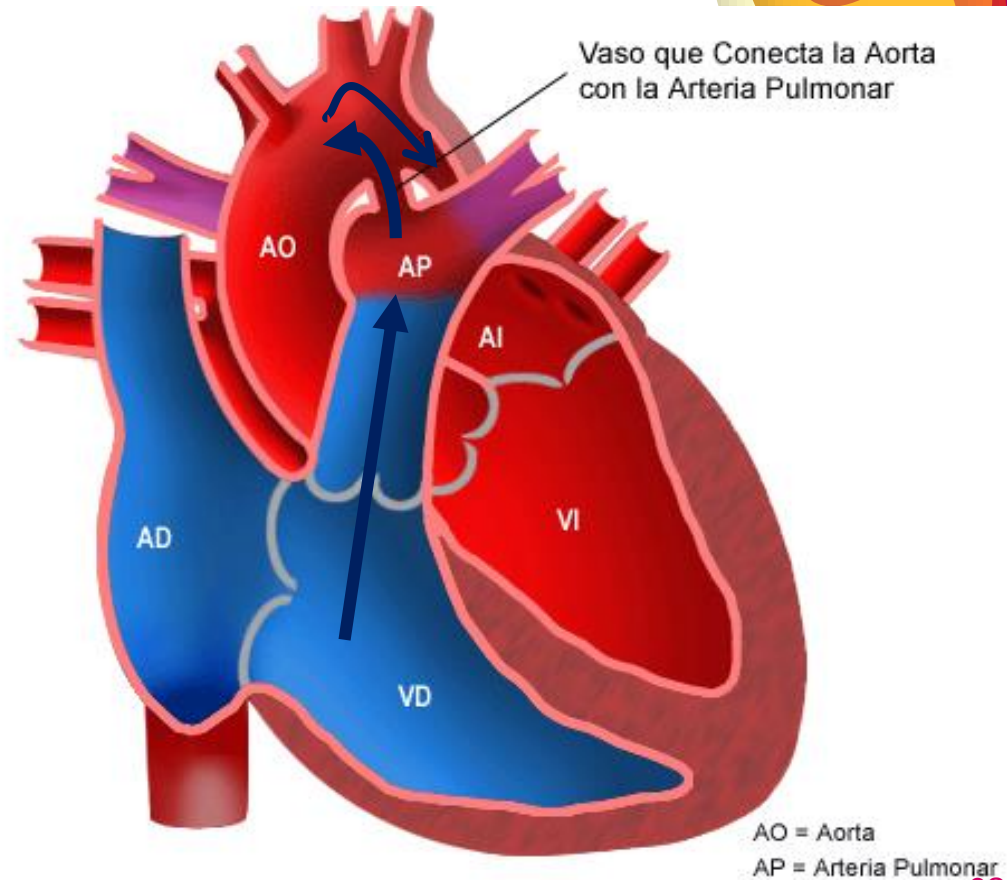
Circulação fetal

- Foramen oval – comunicação átrio direito e átrio esquerdo



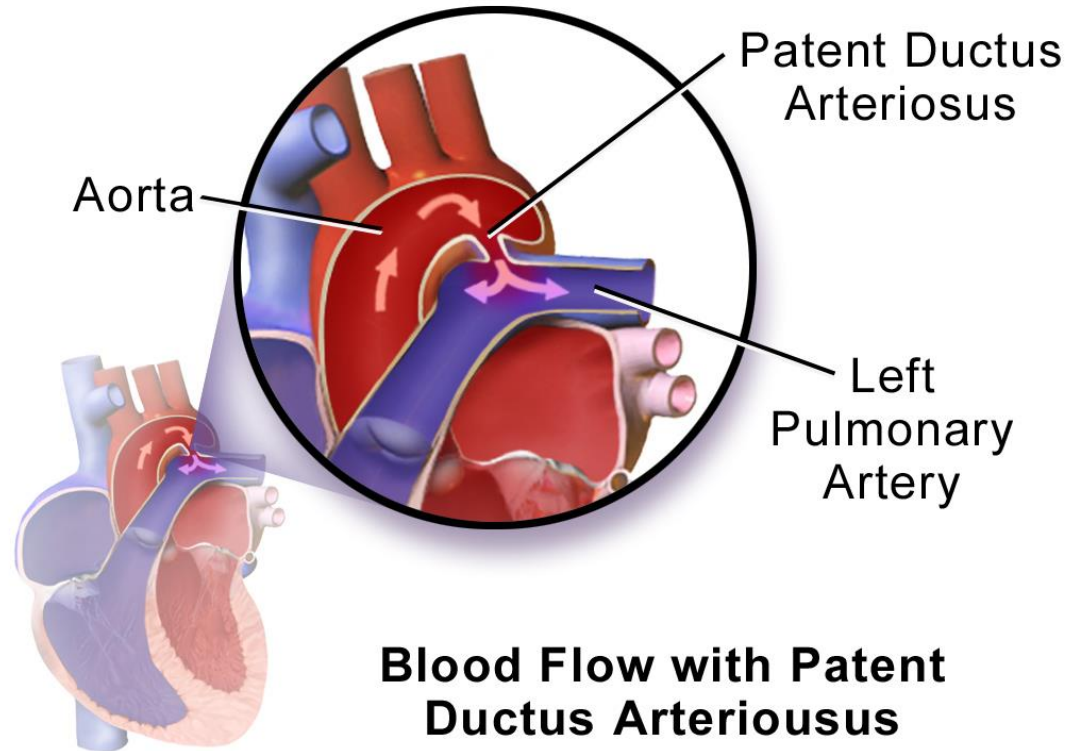
Circulação fetal

- Ducto arterioso – conexão ramo artéria pulmonar e a aorta proximal descendente



Circulação fetal

- Ducto arterioso – conexão ramo artéria pulmonar e a aorta proximal descendente



Transição feto-neonatal

1

Aumento débito cardíaco

Para manter o metabolismo basal, esforço respiratório e termogênese

2

Fim da circulação placentária de baixa resistência

Aumento fluxo sanguíneo na circulação pulmonar (início fechamento ducto arterioso)

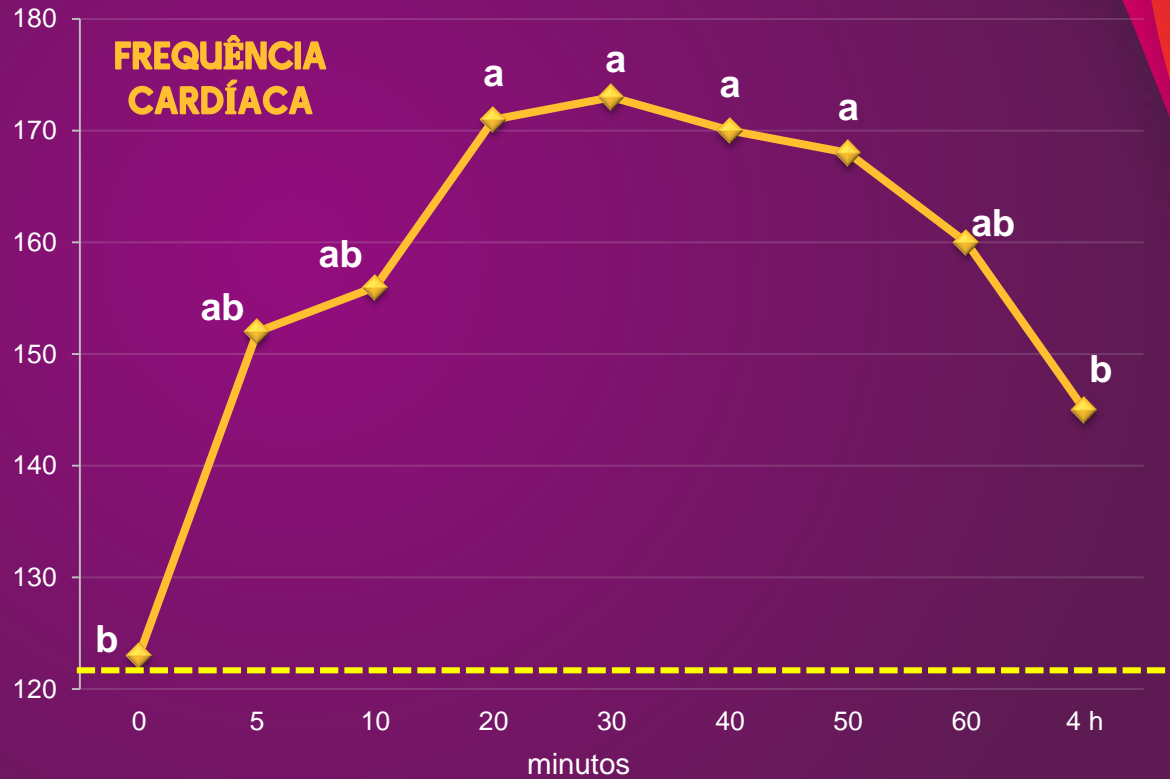
3

Exposição fetal à hipóxia seguida de hiperóxia

Diminuição da resistência vascular pulmonar e aumento fluxo sanguíneo para os pulmões



Vannucchi et al. (2018)



4. Adaptação respiratória

Fluido fetal pulmonar, respiração ao nascimento, mudanças pulmonares



Modificações pulmonares

1

Absorção de líquidos =
Clearance pulmonar

2

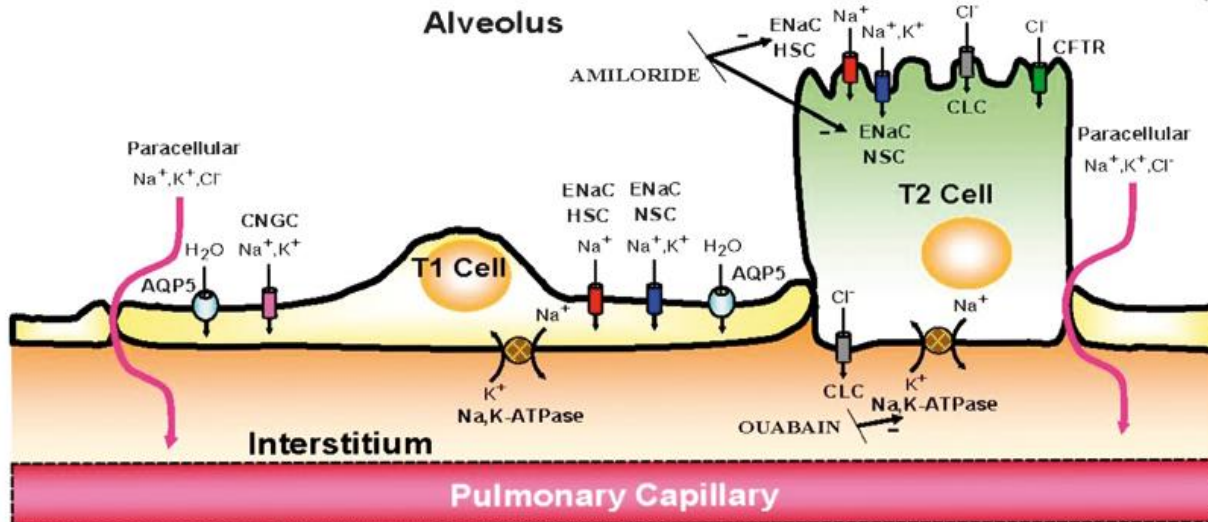
Síntese e ação do surfactante

3

Expansão das áreas
pulmonares

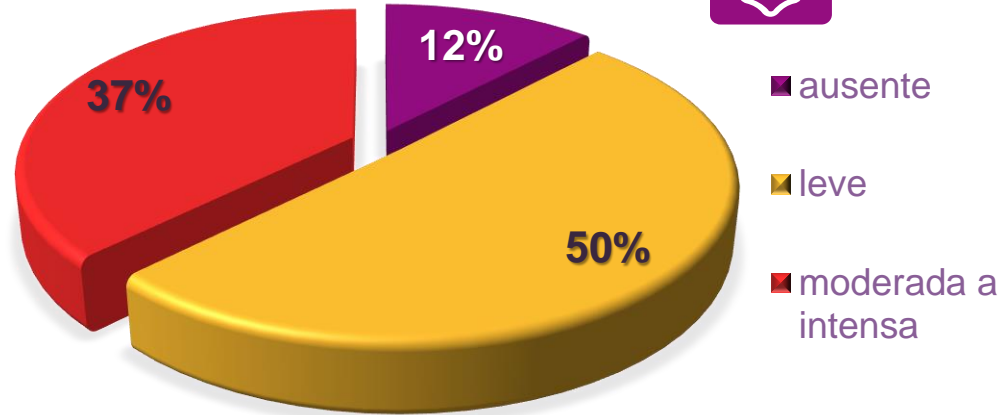
Clearance pulmonar

- Transporte vetorial de íons
- Movimentação osmótica de fluidos

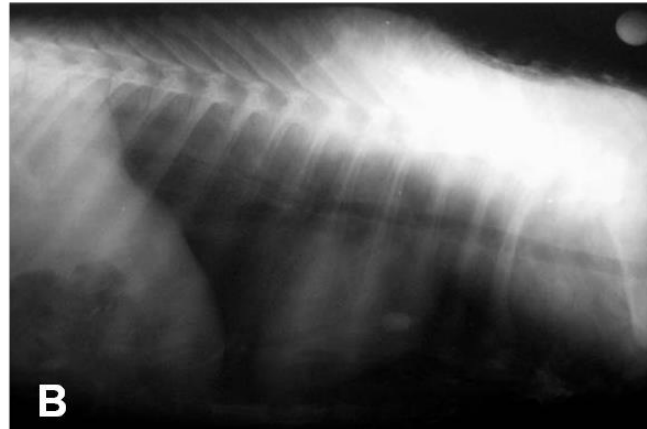
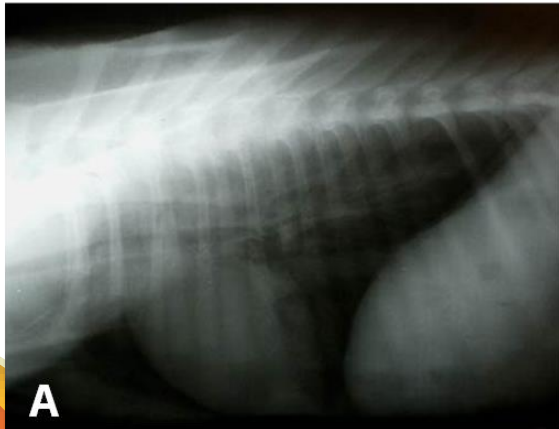


Jain (2008)

Avaliação radiográfica pulmonar (*clearance*)

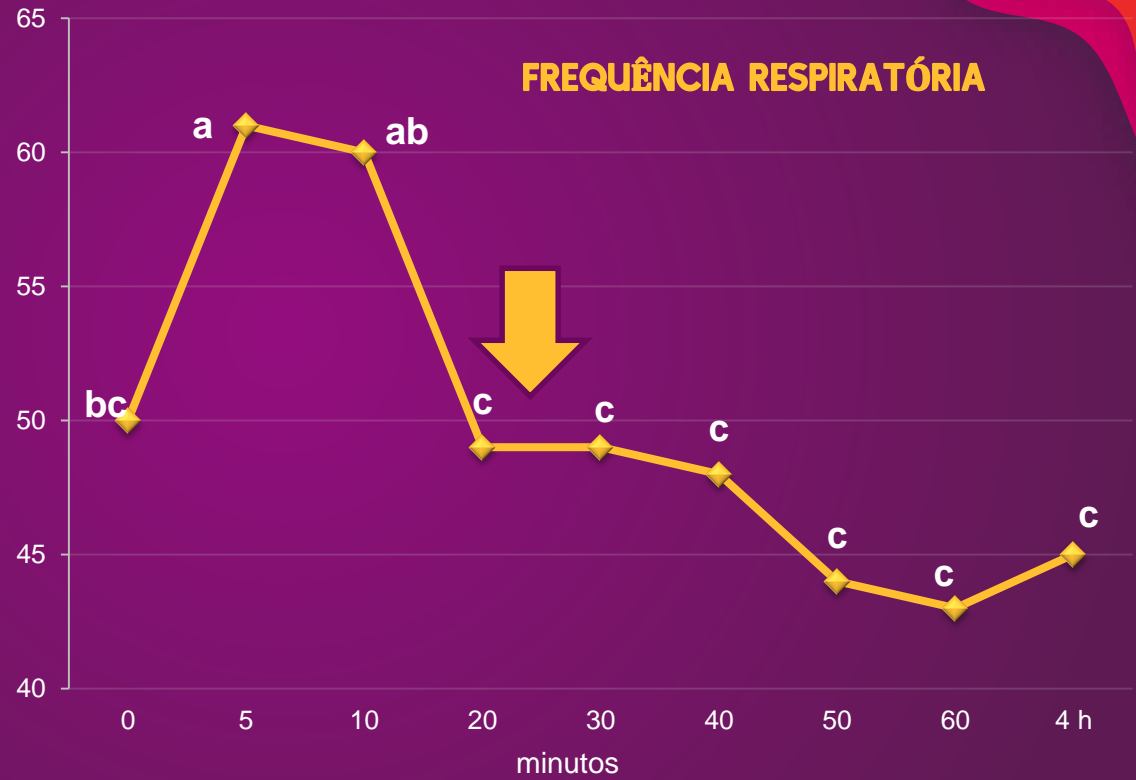


Vannucchi et al. (2018)



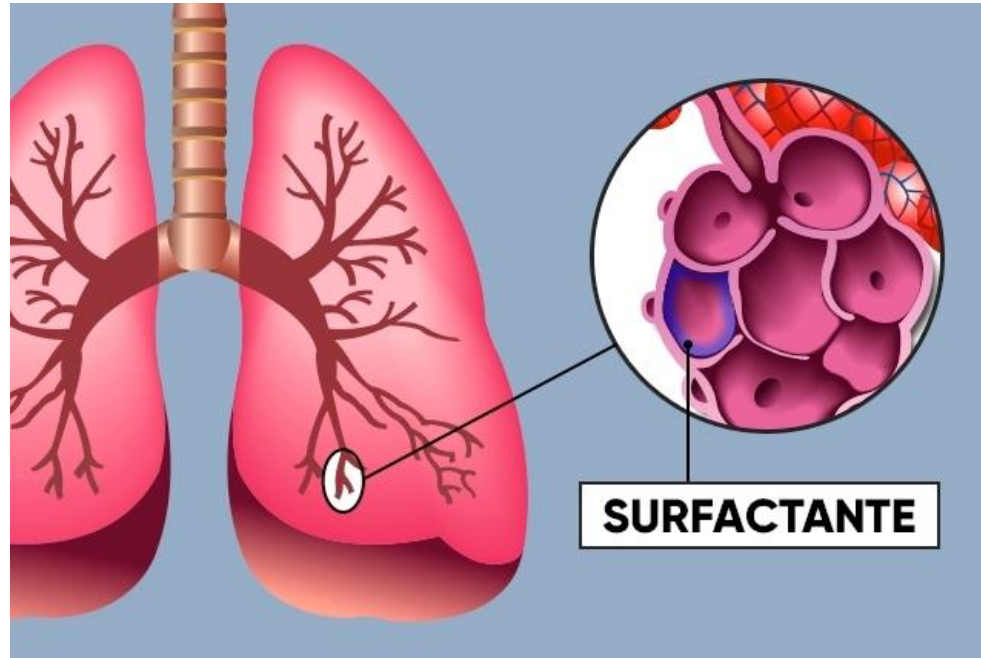


Vannucchi et al. (2018)

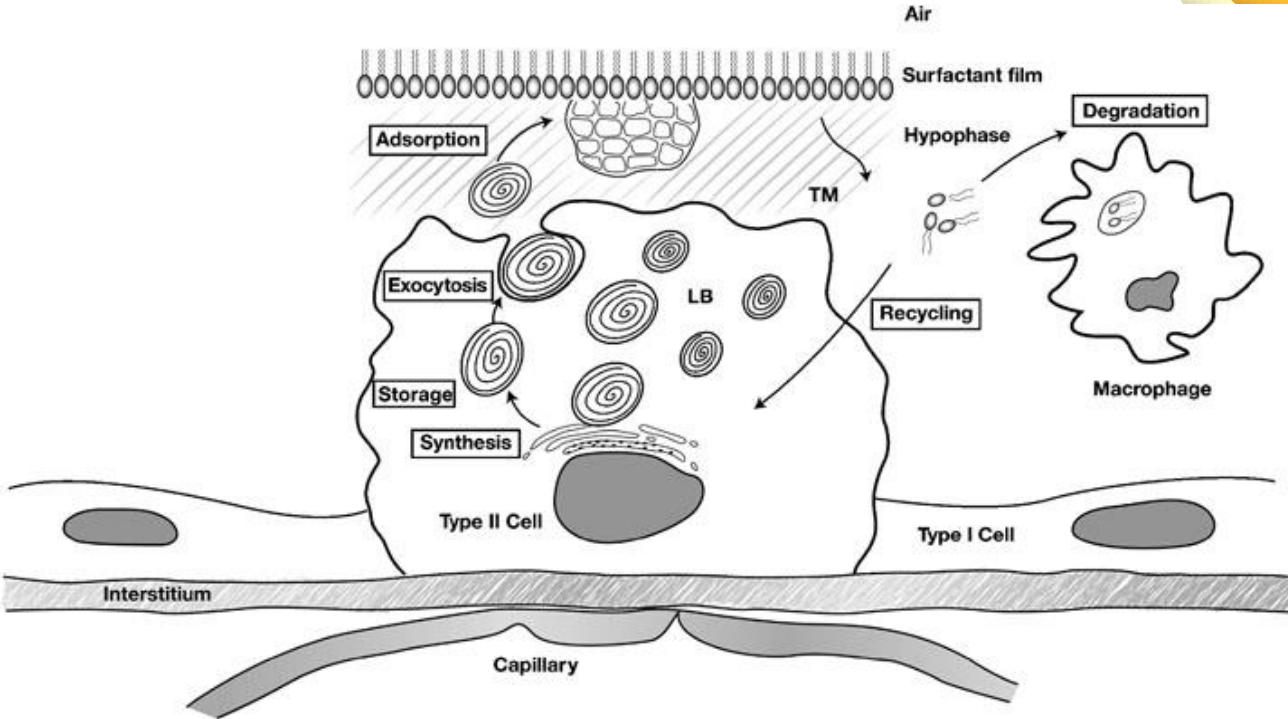


Síntese e ação do surfactante

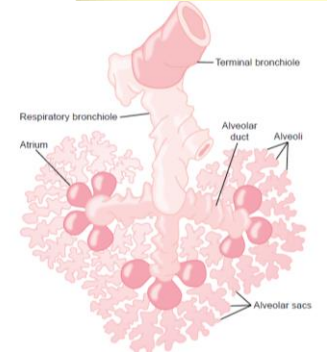
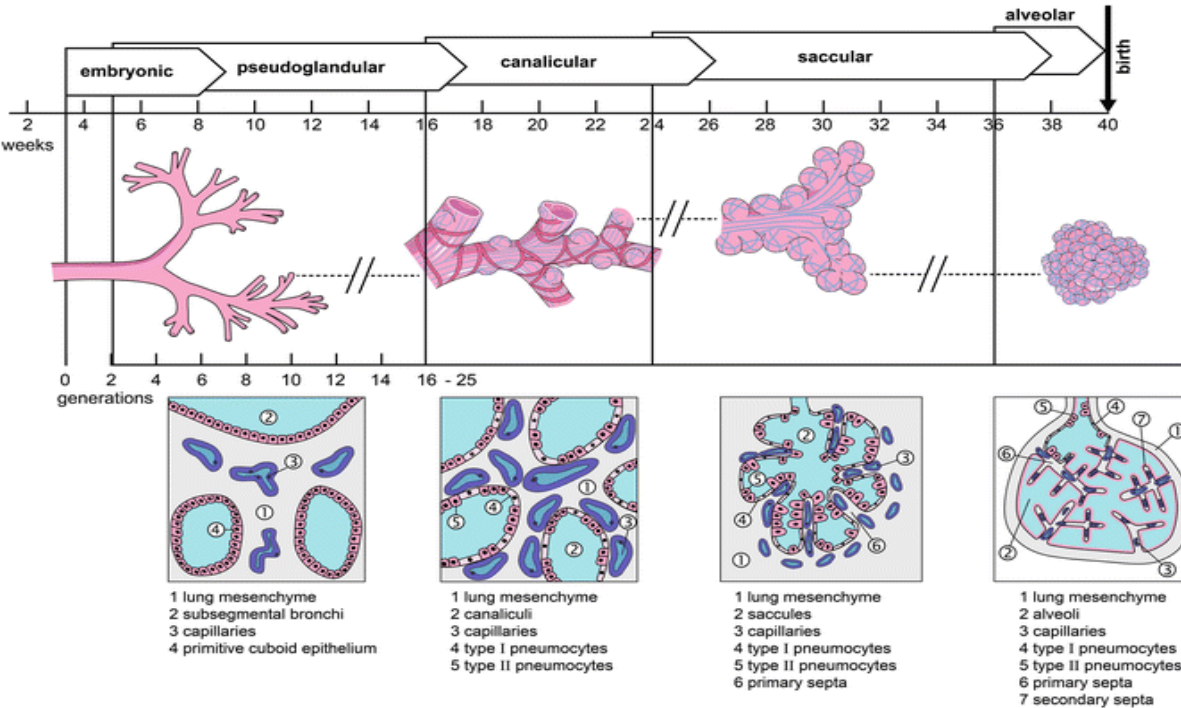
- Redução da tensão superficial da água
- Evitando o colapso alveolar



Síntese e ação do surfactante



Expansão das áreas pulmonares e trocas gasosas



(Bohnhorst and Peter, 2016)

A stylized white icon of a pair of lungs with a central trachea and bronchi, surrounded by five white stars of varying sizes. The icon is centered within a dark purple, irregularly shaped area that is part of a larger, multi-layered, colorful graphic resembling a cross-section of a lung or a biological structure. The layers transition from yellow on the outside to red, then orange, and finally purple in the center.

Fase alveolar completa

Nos bovinos, ocorre pós-natal

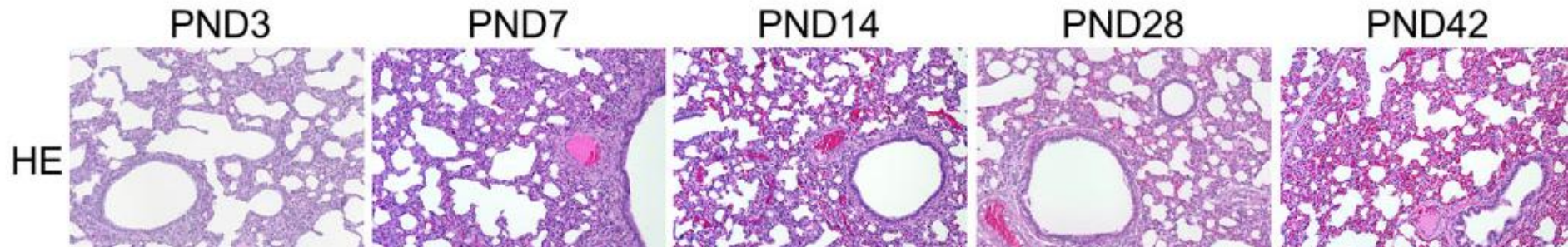


Influence of Nutrition and Maternal Bonding on Postnatal Lung Development in the Newborn Pig

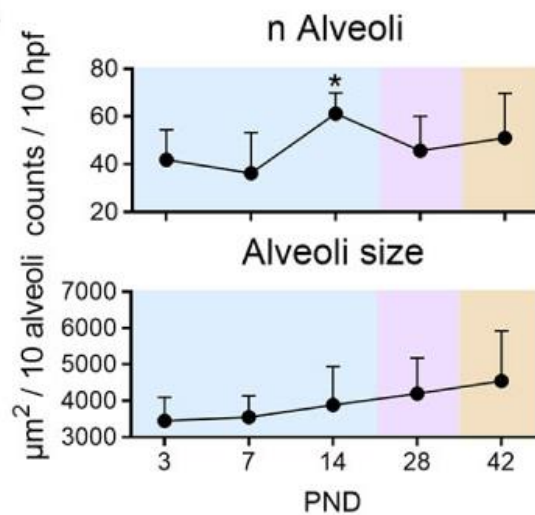
Josephine Schlosser-Brandenburg^{1*}, Friederike Ebner¹, Robert Klopfeisch²,
Anja A. Kühn³, Jürgen Zentek⁴, Robert Pieper^{4,5††} and Susanne Hartmann^{1‡}

OPEN ACCESS

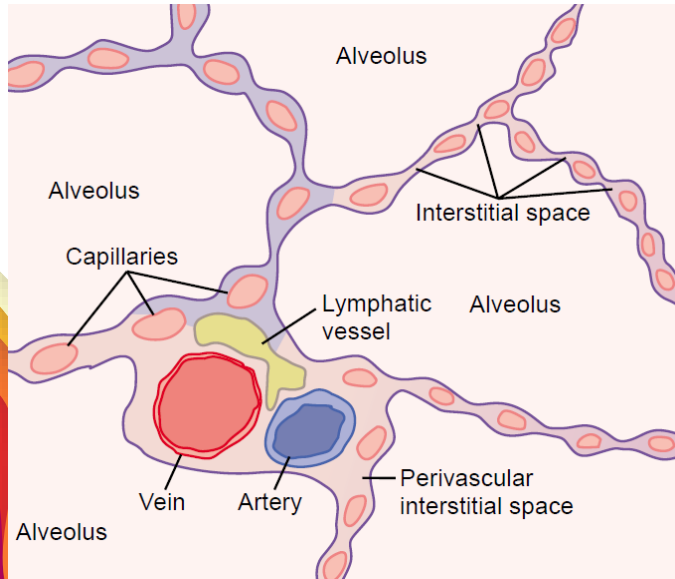
B



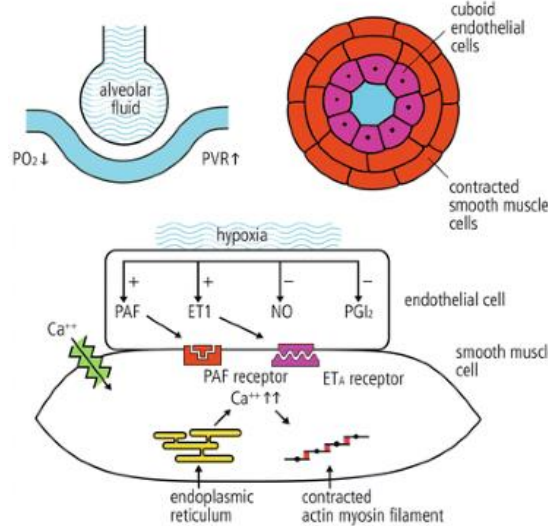
C



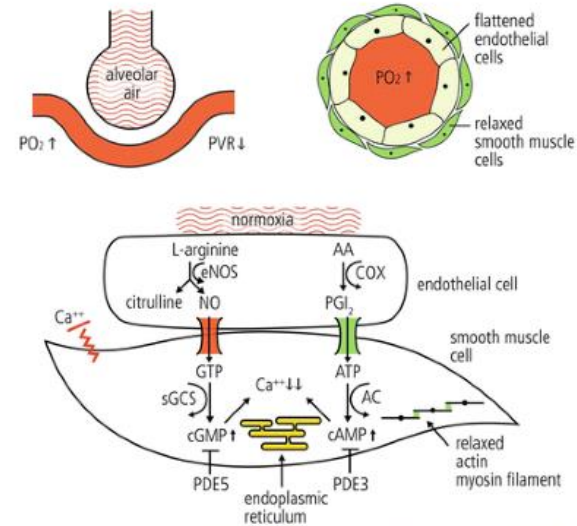
Expansão das áreas de trocas gasosas



Prenatal: pulmonary vasoconstriction



Postnatal: pulmonary vasodilation





Oxidative stress and acid–base balance during the transition period of neonatal Holstein calves submitted to different calving times and obstetric assistance

Camila I. Vannucchi,* Liege G. Silva, Cristina F. Lúcio, and Gisele A. L. Veiga
Department of Animal Reproduction, School of Veterinary Medicine and Animal Science, University of São Paulo, São Paulo
Brazil 05508-270

Table 1. Arterial blood gas values (means \pm SEM) of calves at birth (0 min) and 120 and 240 min after birth

Variable ¹	0 min	120 min	240 min
pH	7.23 \pm 0.02 ^b	7.38 \pm 0.01 ^a	7.41 \pm 0.01 ^a
Bicarbonate (mmol/L)	20.5 \pm 0.8 ^b	23.9 \pm 0.6 ^a	25.1 \pm 0.5 ^a
TCO ₂ (mmol/L)	21.9 \pm 0.8 ^b	25 \pm 0.6 ^a	26.2 \pm 0.6 ^a
Base excess (mmol/L)	5.4 \pm 1.1 ^b	0.9 \pm 0.7 ^a	0.7 \pm 0.5 ^a
pO ₂ (mmHg)	52.4 \pm 4.1 ^b	59.9 \pm 2.8 ^{ab}	68.9 \pm 3.3 ^a
sO ₂ (%)	64.7 \pm 2.4 ^b	84.4 \pm 1.3 ^a	88.8 \pm 1.1 ^a
K ⁺ (mmol/L)	4.0 \pm 0.2	4.0 \pm 0.1	4.0 \pm 0.5
Na ⁺ (mmol/L)	136.8 \pm 0.5	136.9 \pm 0.4	137.0 \pm 0.5

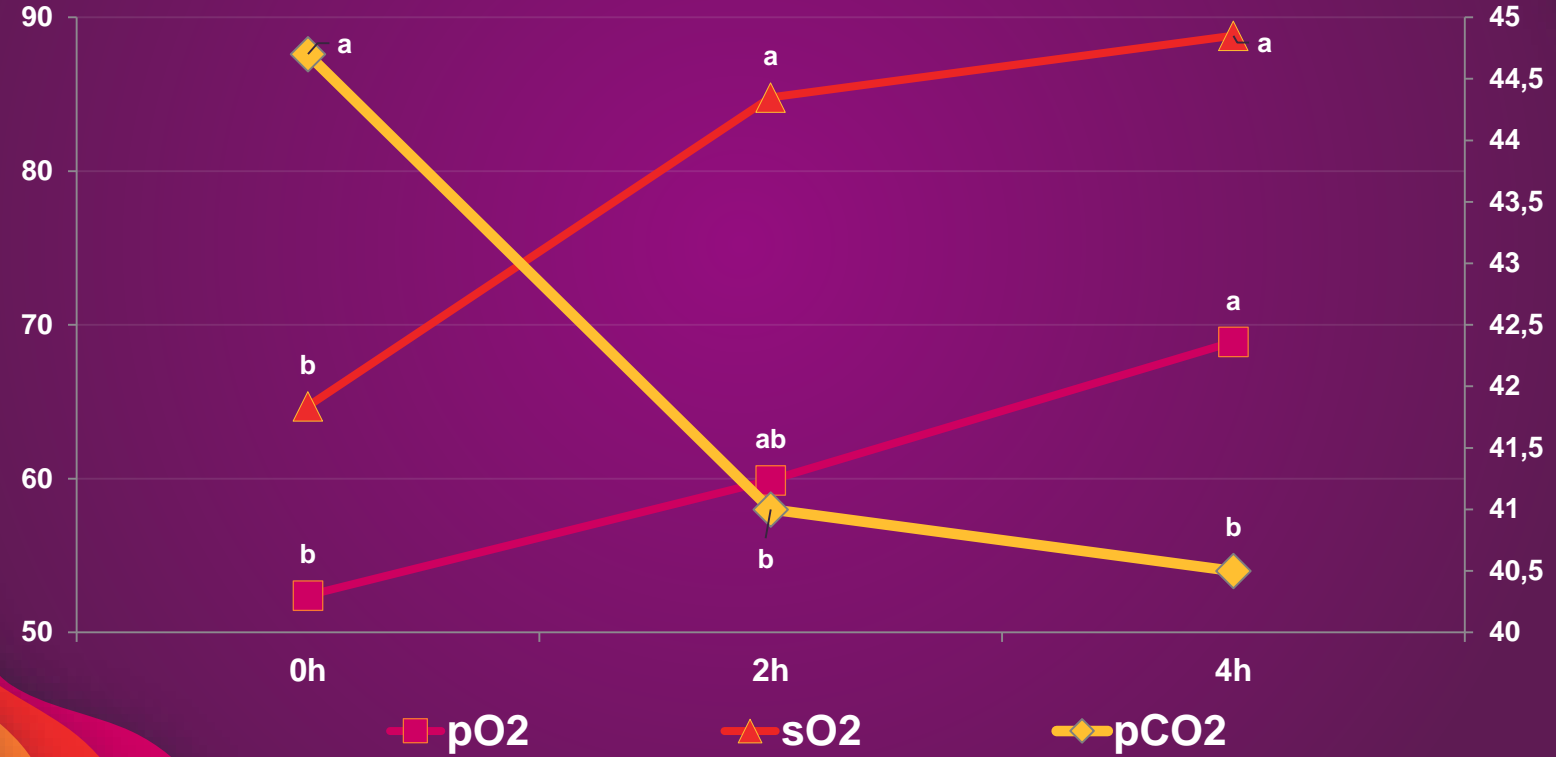
^{a,b}Values within a row (across evaluation times) with different superscripts differ ($P < 0.05$).

¹TCO₂ = total CO₂; pO₂ = partial pressure of O₂; sO₂ = oxygen saturation.



Oxidative stress and acid–base balance during the transition period of neonatal Holstein calves submitted to different calving times and obstetric assistance

Camila I. Vannucchi,* Liege G. Silva, Cristina F. Lúcio, and Gisele A. L. Veiga
Department of Animal Reproduction, School of Veterinary Medicine and Animal Science, University of São Paulo, São Paulo, Brazil 05508-270





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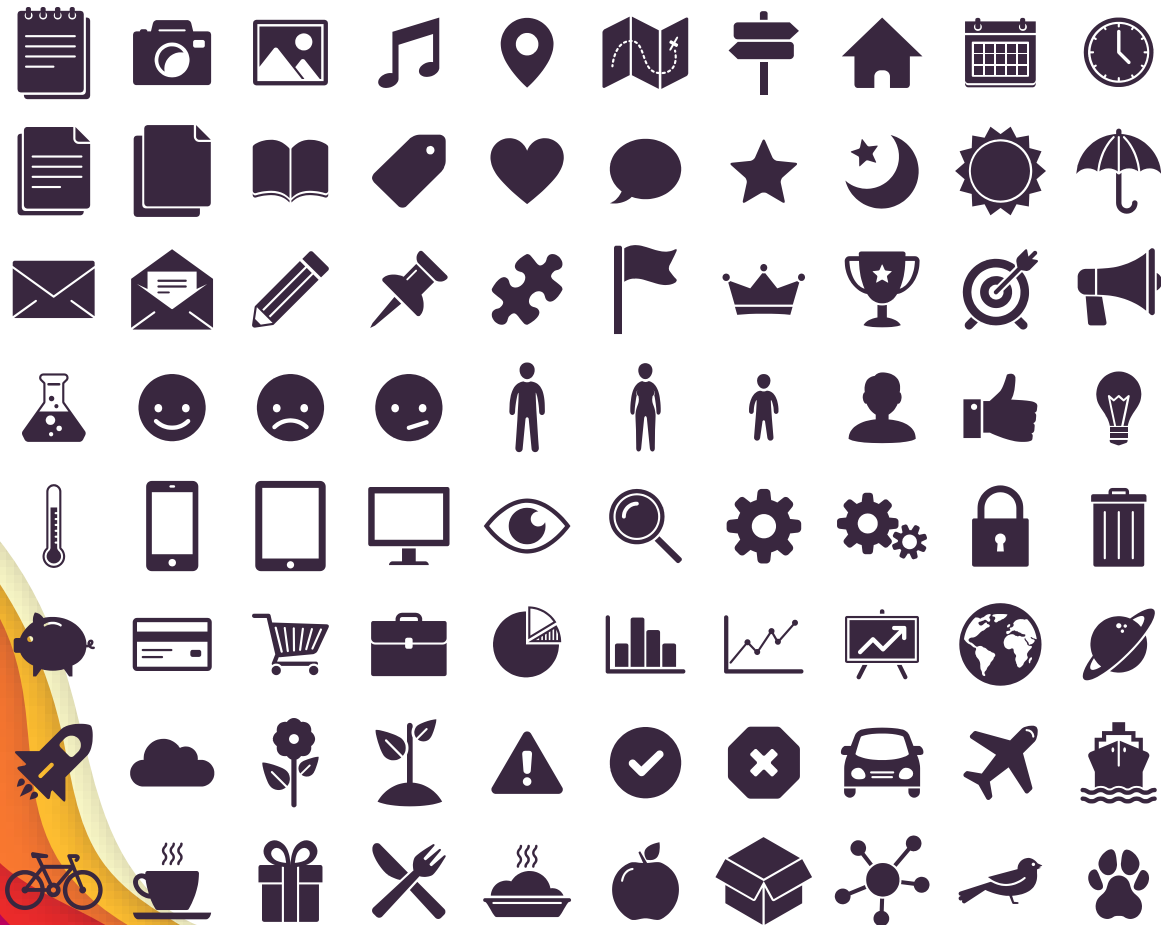
Existe o tempo certo das coisas.
Querer acelerá-lo é o risco que
se corre para danos imediatos
ou futuros.

Camila Infantosi Vannucchi



cacavann@usp.br





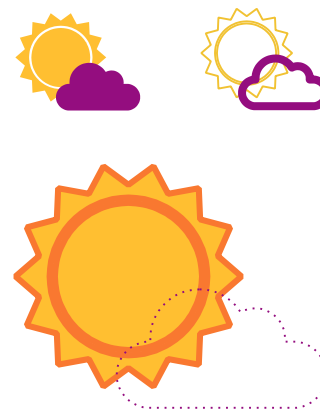
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Diagrams and infographics

