PIPADOR REVISION

MRCOG Part 1 Revision Notes

Acid–Base Changes in Pregnancy

BIOCHEMISTRY • LECTURE 236

VISUAL EXAMINATION REVISION NOTES

2026 Edition

MRCOG PART 1 REVISION NOTES | BIOCHEMISTRY

236 Acid–Base Changes in Pregnancy

Compensated respiratory alkalosis, normal values in pregnancy and labour, abnormal gases and fetal acid–base

3.7–4.2	18–22	7.40–7.47	≈ −2 to −3
$PaCO_2$ (kPa) in pregnancy	HCO_3^- (mmol/L)	pH (slightly alkalaemic)	Base excess

■ KEY FACTS: Learning objectives

- Describe the respiratory and renal mechanisms of the acid–base changes of pregnancy.
- Describe normal blood gas values in pregnancy and labour, and fetal/maternal CO_2 gradients.
- Interpret abnormal gases in pregnancy (asthma, DKA, sepsis, hyperemesis) and describe fetal acid–base physiology.

236.1 Mechanism — compensated respiratory alkalosis

Progesterone ↑ respiratory centre sensitivity to CO_2 ▶ ↑ **Tidal volume** → minute ventilation ↑ 40–50% ▶ **$PaCO_2$ falls** to ≈ 4 kPa (primary respiratory alkalosis) ▶ Kidneys excrete HCO_3^- → **HCO_3^- 18–22 mmol/L** ▶ **pH 7.40–7.47** (mildly alkaline); ↓ buffering capacity

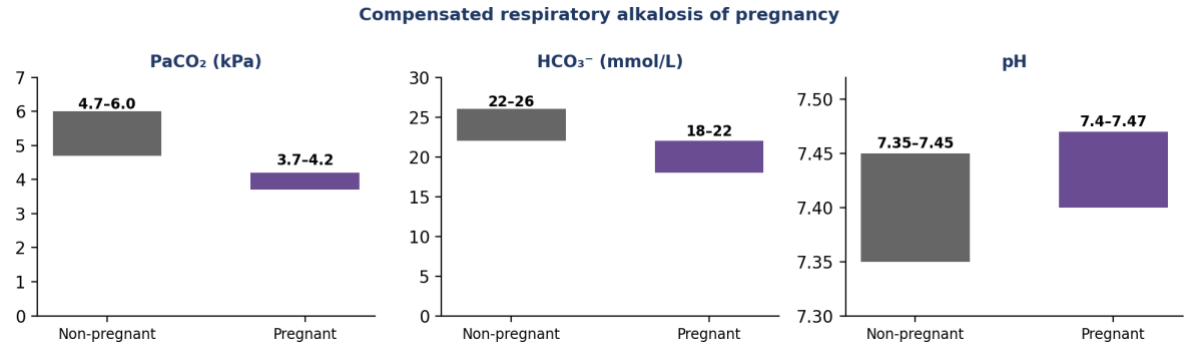


Figure 236.1 — Blood gases in non-pregnant vs pregnant women

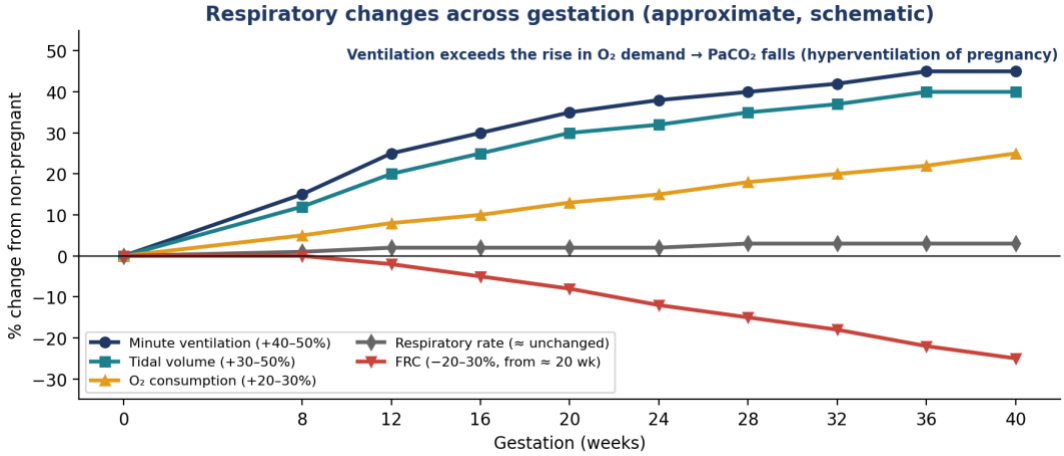


Figure 236.2 — Ventilatory changes across gestation

236.2 Physiological purpose

- **Maternal $PaCO_2$ ≈ 4 kPa** creates a steep **fetus → mother CO_2 gradient** (fetal umbilical arterial PCO_2 ≈ 6.5–7 kPa) for efficient fetal CO_2 elimination (double Haldane effect).
- Maternal alkalosis left-shifts the ODC, but **↑ 2,3-BPG** right-shifts it (P50 ↑) → net O_2 release to the placenta (Lecture 131).
- Reduced HCO_3^- = **less buffer** → metabolic acidosis develops faster (sepsis, DKA, haemorrhage).

236.3 Labour

- **Pain-driven hyperventilation** can lower $PaCO_2$ to < 2.7 kPa → marked respiratory alkalosis: tingling, carpopedal spasm (↓ ionised Ca^{2+}), dizziness; **uterine vasoconstriction** and hypoventilation between contractions (maternal hypoxaemia) — **epidural analgesia** abolishes this.
- Prolonged labour/exertion and fasting → **lactate and ketones** → mild **metabolic acidosis** (↑ base deficit) — physiological up to a point; avoid prolonged starvation in labour.

236.4 Interpreting abnormal gases in pregnancy

Scenario	Interpretation
Severe asthma	A 'normal' $PaCO_2$ (≥ 4.6–5 kPa) is abnormal — CO_2 retention from exhaustion → life-threatening; escalate to critical care
DKA	Occurs at lower glucose (accelerated starvation, low buffer reserve) — ↑ anion gap metabolic acidosis; fetal acidosis and death risk
Sepsis / haemorrhage	Lactic acidosis develops early; lactate ≥ 2 mmol/L is a red flag; base deficit guides resuscitation
Hyperemesis gravidarum	Hypochloraemic, hypokalaemic metabolic alkalosis (vomiting) ± ketosis; dehydration; thiamine
Pulmonary embolism	Respiratory alkalosis is the baseline — hypoxaemia/↑ A–a gradient is more informative
$MgSO_4$ / opioid toxicity	Respiratory acidosis (↑ $PaCO_2$)
AFLP, renal failure	High anion gap metabolic acidosis, hypoglycaemia

236.5 Fetal acid–base

Feature	Details
Fetal 'normal'	Lower pH and PO_2, higher PCO_2 than adult; umbilical artery pH ≈ 7.20–7.30, vein ≈ 7.30–7.40 (Lecture 128)
Respiratory acidosis	Acute cord compression → ↑ PCO_2, normal base deficit — rapidly reversible
Metabolic acidosis	Prolonged hypoxia → anaerobic lactate → ↑ base deficit; pH < 7.00 + BD ≥ 12 mmol/L = significant (HIE risk)
Fetal blood sampling	pH ≤ 7.20 or lactate ≥ 4.9 mmol/L abnormal (Lecture 159)
Maternal influences	Maternal hyperventilation, DKA, sepsis and hypotension alter fetal acid–base; maternal bicarbonate infusion crosses slowly (CO_2 crosses rapidly)

236.6 Must-know summary

■ EXAM TIP

- Pregnancy = **compensated respiratory alkalosis**: $PaCO_2$ 3.7–4.2 kPa, HCO_3^- 18–22, pH 7.40–7.47.
- Driven by **progesterone** (↑ CO_2 sensitivity, ↑ tidal volume).
- Purpose: fetal CO_2 gradient; cost: ↓ buffer → faster metabolic acidosis.
- $PaCO_2$ of 5 kPa in a pregnant asthmatic = **danger**; hyperemesis → metabolic alkalosis; DKA at lower glucose.
- Cord gas: pH < 7.00 + BD ≥ 12 = significant metabolic acidaemia.

■ MNEMONIC / MEMORY AID

Pregnancy ABG — '4, 20, 7.44': $PaCO_2$ ≈ 4 kPa, HCO_3^- ≈ 20, pH ≈ 7.44.