

Variation in the $\text{PaO}_2/\text{FiO}_2$ ratio with FiO_2 : Mathematical and experimental description and clinical relevance

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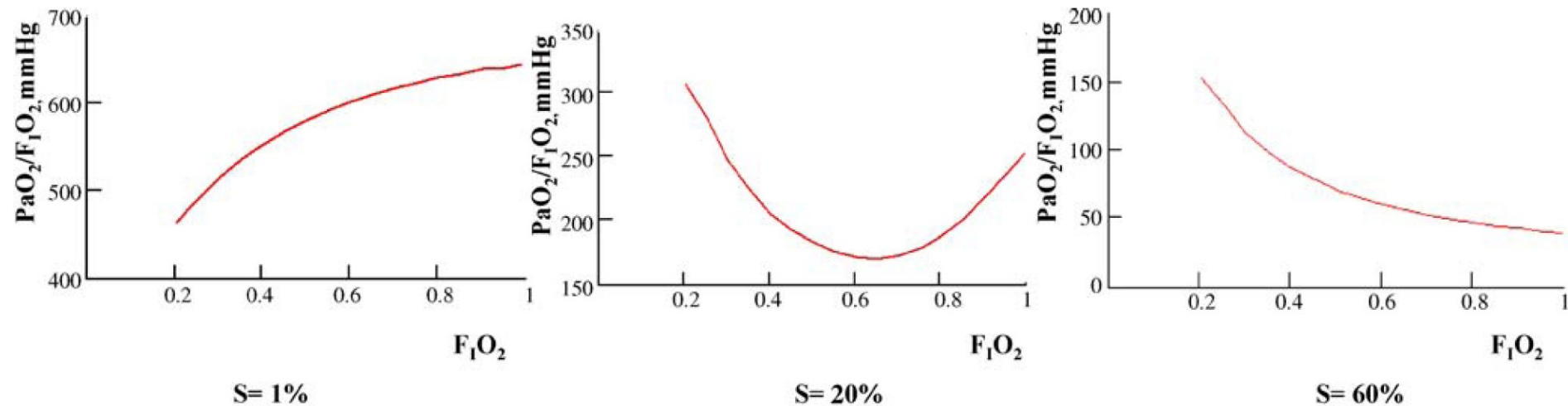


Definition of ALI and ARDS

- The acute onset of respiratory failure.
- Bilateral infiltrates seen on frontal chest radiograph.
- No evidence of left atrial hypertension.
- The following values of the $\text{PaO}_2/\text{FiO}_2$ ratio
 - ALI, $27 \text{ kPa} \leq \text{PaO}_2/\text{FiO}_2 < 40 \text{ kPa}$
 - ARDS, $\text{PaO}_2/\text{FiO}_2 < 27 \text{ kPa}$

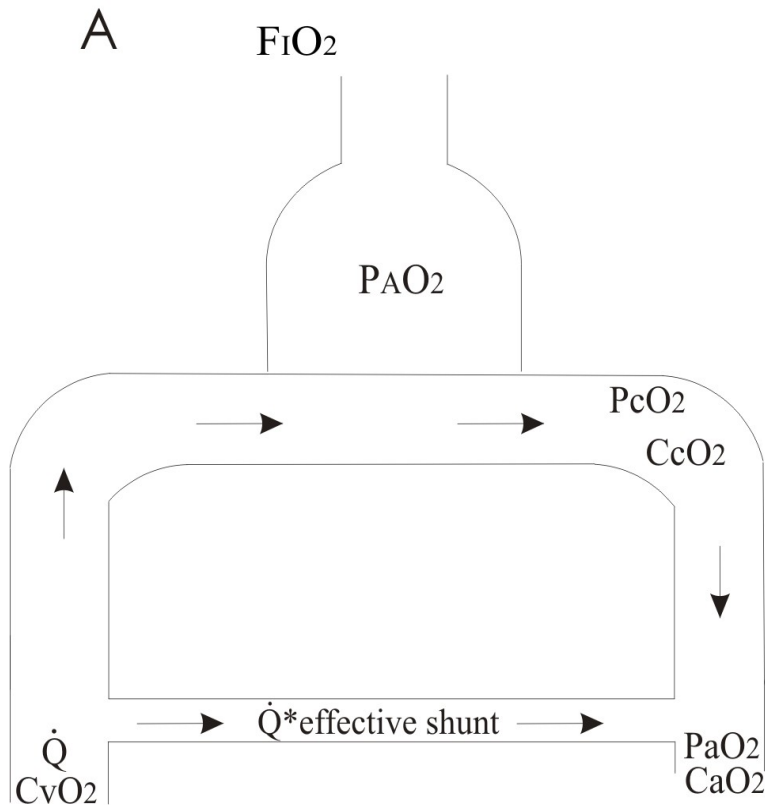
Bernard et al., AJRCCM, 1994, 149, 818-824

Critique of the use of the PaO₂/FiO₂ ratio



Aboab et.al, Relation between PaO₂/FiO₂ and FiO₂: a mathematical description, ICM, 2006, 32: 1494-1497.

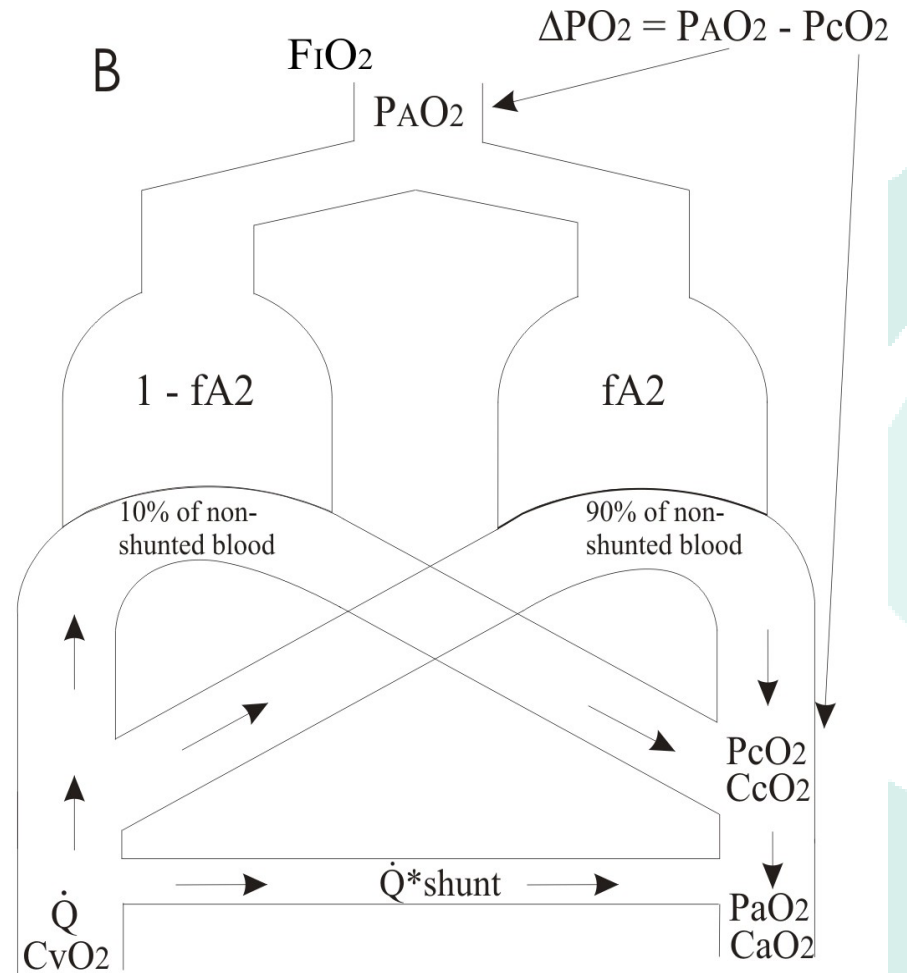
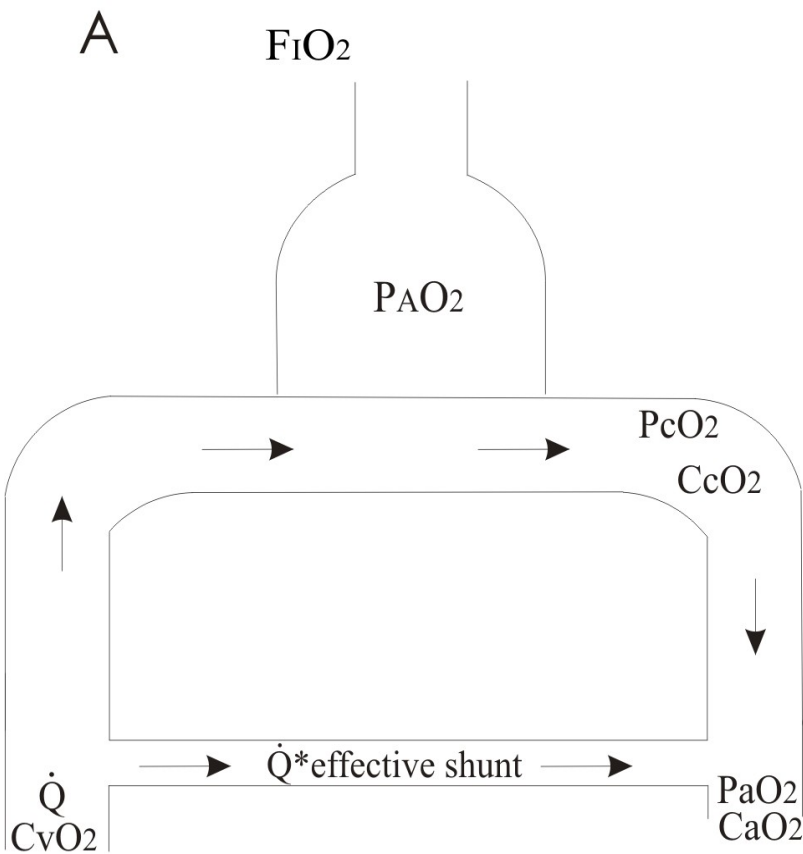
Limitations of Aboab's simulations



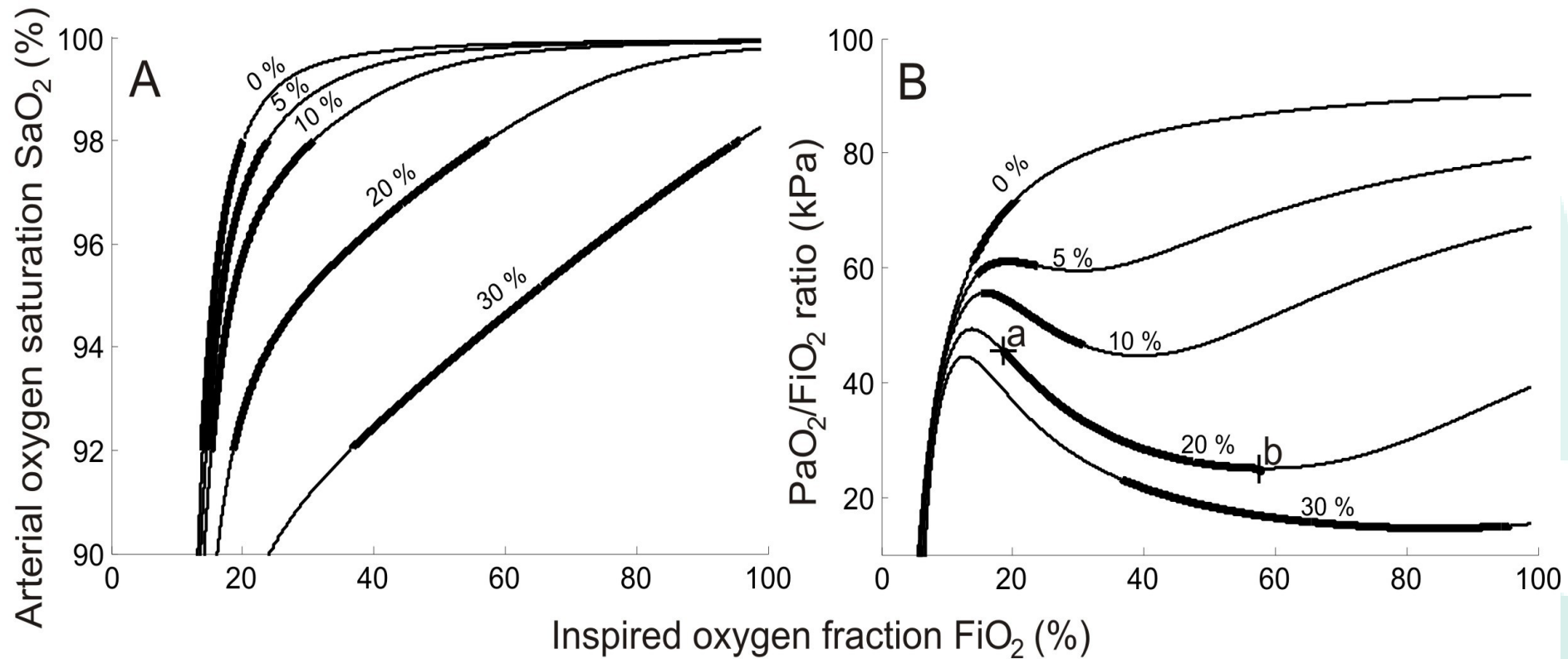
- Computer simulations, no measured data
- Simulations performed with a model well known to be a poor approximation to the effects of varying F_{IO_2}

"changes in F_{IO_2} influence the intrapulmonary shunt fraction, which included the true shunt plus ventilation perfusion mismatching"

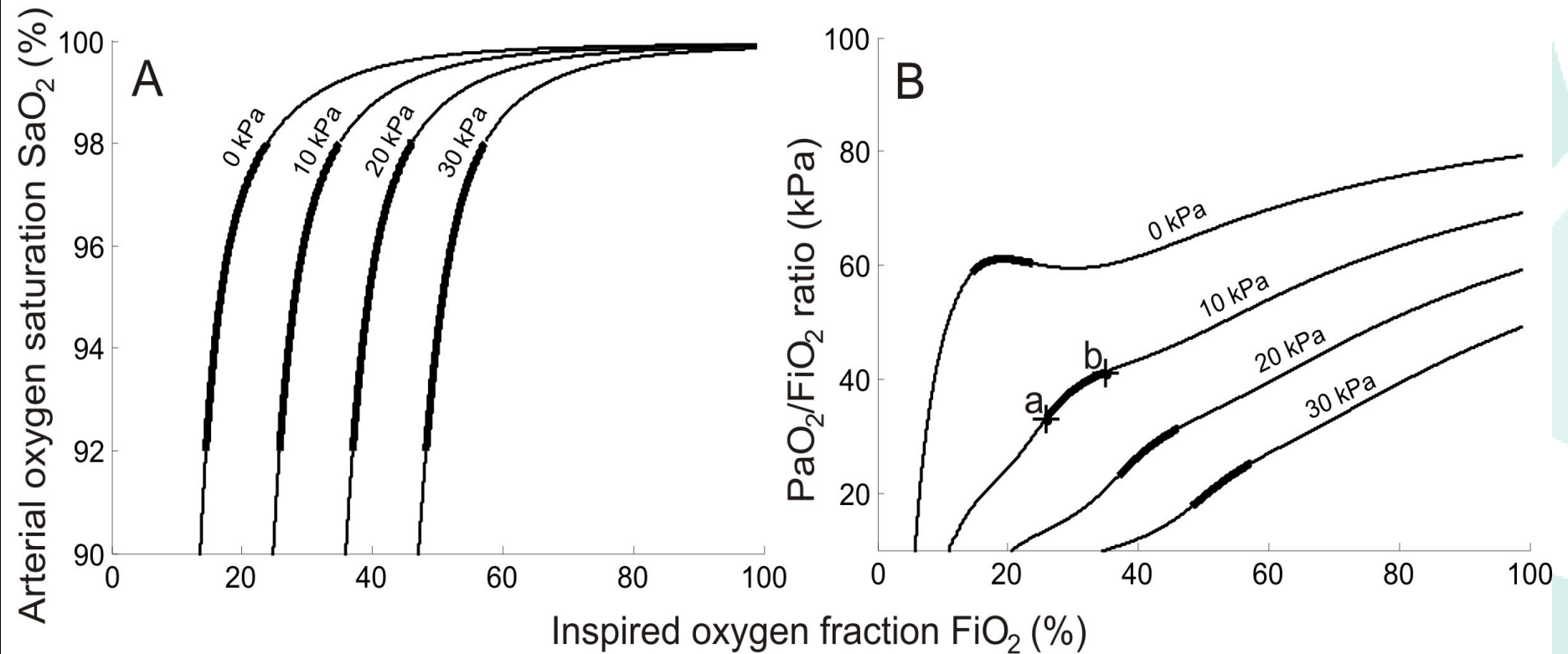
Modelling including shunt and V/Q mismatching



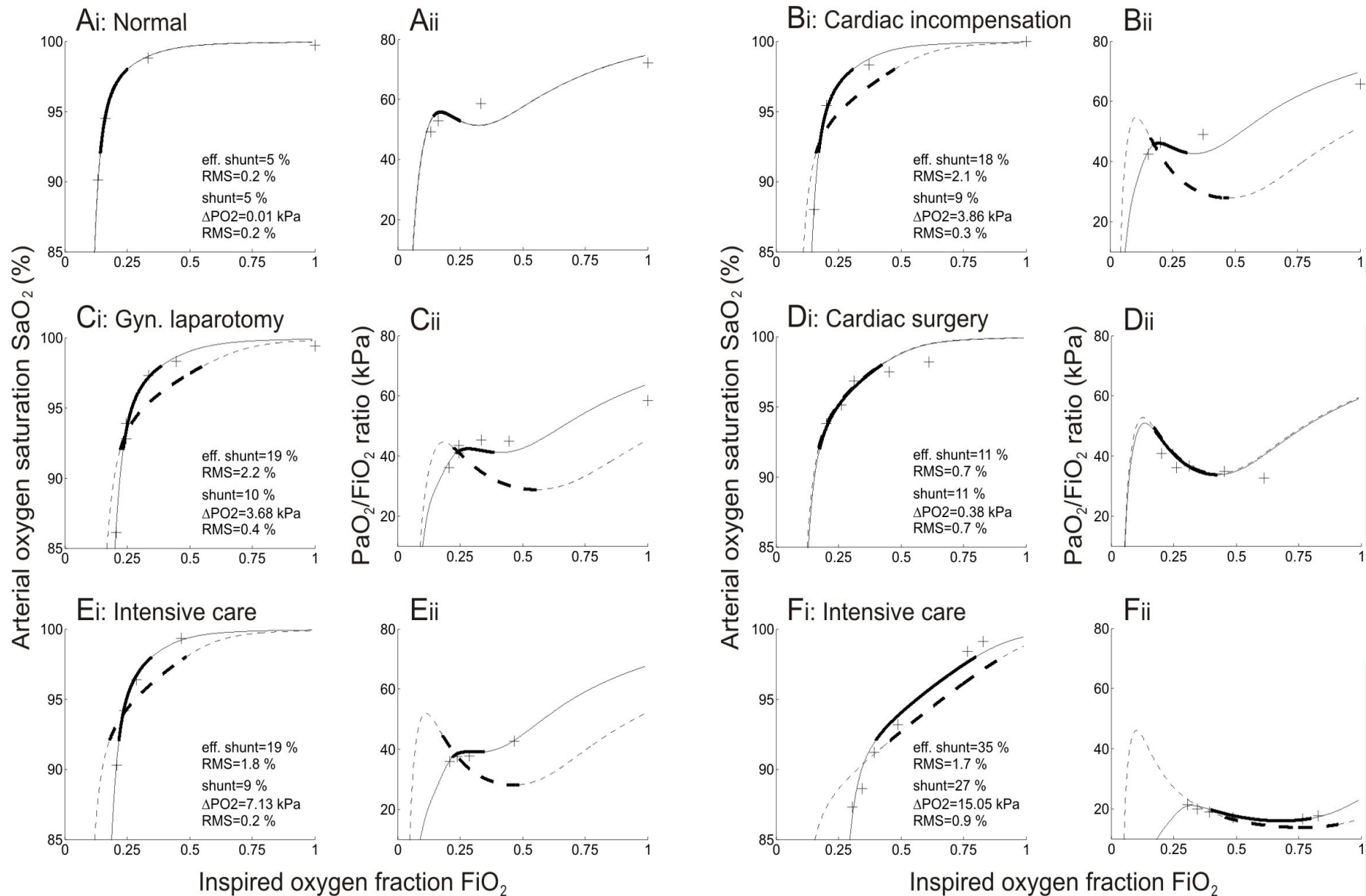
Simulations of the effects of shunt



Simulations of the effects of V/Q mismatch



Patient examples: which model is best?



Using the shunt + V/Q model, what are the consequences for PaO₂/FiO₂.

V/Q and shunt model

Low FiO ₂	High FiO ₂			
	Normal: 42	Mild Hypoxemia: 19	ALI: 31	ARDS: 24
Normal: 56	39	12	5	0
Mild hypoxemia: 19	3	6	9	1
ALI: 23	0	1	16	6
ARDS: 18	0	0	1	17

* Normal (PaO₂/FiO₂ > 47 kPa) [19], Mild Hypoxemia (40 ≤ PaO₂/FiO₂ < 47 kPa), ALI (27 ≤ PaO₂/FiO₂ < 40 kPa) [4,5], ARDS (PaO₂/FiO₂ < 27 kPa) [4,5].

Conclusions: How should we define ALI and ARDS.

- If we are to use $\text{PaO}_2/\text{FiO}_2$ we should at least define the level of FiO_2 at which it is specified (this still does not make it comparable between patients).
- Perhaps the definition of ALI and ARDS should be made using more complex oxygenation indices including both shunt and V/Q components.