

Gas Man derived compartmental and Lerou physiological model vs Lu et al clinical data for desflurane

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Introduction

The parsimonious compartmental models of volatile agents are important because they can be fitted to clinically data available in the operating room and can be used to describe the course of the partial pressure over time.

The end tidal desflurane concentrations are available clinically but the brain concentrations, which is the effect site, are directly tied to effect.

The usefulness of the pharmacokinetic models depends on their accuracy.

We evaluated the prediction of both the end tidal and effect site brain concentrations of desflurane of the Gas Man derived compartmental model and the Leroux physiological model vs the Lu et al clinical data.

Methods

Lu et al measured the end tidal (Ce) and the jugular-bulb (Cj), surrogate for effect site, brain (Fb), concentrations of desflurane in 13 patients undergoing elective coronary artery bypass grafting.

The patients were volume controlled ventilated for 1 hour, fresh gas flow (FGF) 5l/min, vaporizer settings (Fd) 5% [1].

We simulated the end tidal (Fet) and brain (Fb) concentrations for a patient weight $Wt=68kg$, tidal volume $Vt=600cc$, respiratory rate $RR=10$ breath/min for both the Gas Man derived compartmental [2] with an added effect site compartment ($ke0=0.61min^{-1}$) and Lerou physiological model used by AnestAssist program (Palma Healthcare Systems LLC).

The cardiac output (CO), a covariate of the compartmental model, that is not routinely available clinically, was 5l/min, with the caveat that in this patient population it is low and under anesthesia it would decrease even further.

Results

Gas Man derived compartmental model vs Lu clinical data for desflurane

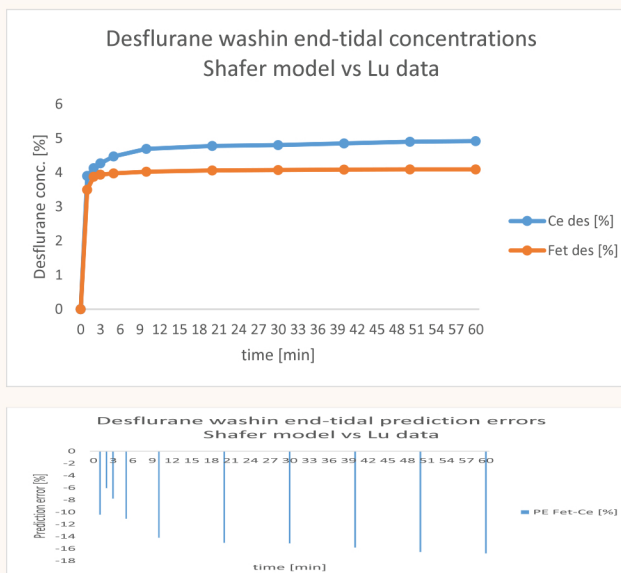


Fig 1 Desflurane end-tidal Shafer model (Fet) vs Lu data (Ce) concentration curves and the prediction errors (PE)

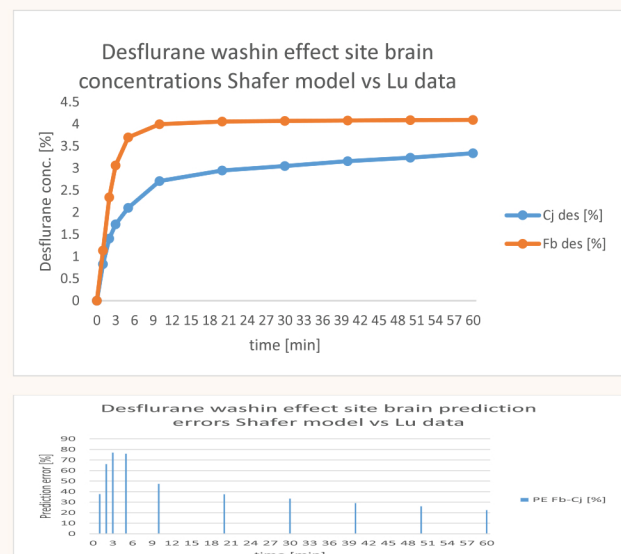


Fig 2 Desflurane effect site brain Shafer model (Fb) vs jugular bulb Lu data (Cj) concentration curves and the prediction errors (PE)

Leroux physiological model vs Lu clinical data for desflurane

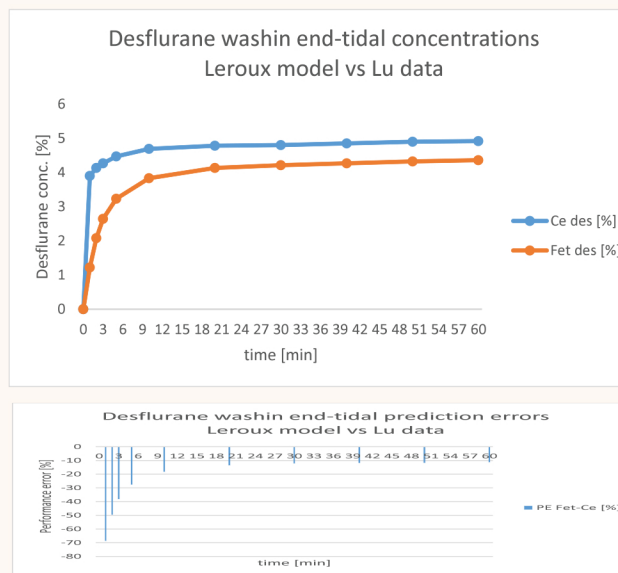


Fig 3 Desflurane end-tidal Leroux model (Fet) vs Lu data (Ce) concentration curves and the prediction errors (PE)

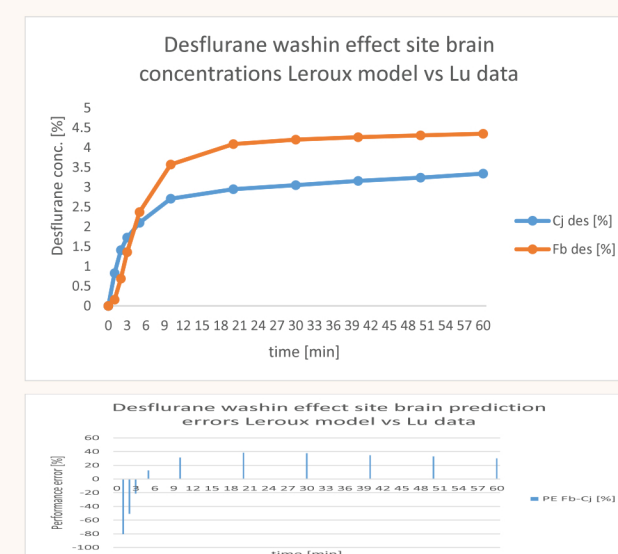


Fig 4 Desflurane effect site brain Leroux model (Fb) vs jugular bulb Lu data (Cj) concentration curves and the prediction errors (PE)

We calculated the median prediction error (MPE) and median absolute prediction error (MAPE), as a measure for bias and accuracy, respectively, for the end tidal and brain concentrations, of the compartmental model and the Lerou physiological model vs the data of Lu et al.[3] (Table 1).

Table 1			
Desflurane Gas Man Derived Compartmental Model vs Lu Data			
MDPE Fet-Ce [%]	MDAPE Fet-Ce [%]	MDPE Fb-Cj [%]	MDAPE Fb-Cj [%]
-13	13	38	38
Desflurane Lerou Physiological Model vs Lu Data			
MDPE Fet-Ce [%]	MDAPE Fet-Ce [%]	MDPE Fb-Cj [%]	MDAPE Fb-Cj [%]
-16	16	22	34

Conclusions

There was no significant difference between the compartmental and physiological models, both estimated the end tidal concentrations (Fet) with good accuracy $<16\%$ with a negative bias, but the accuracy for brain concentrations (Fb) was 38% with a positive bias.

The high predicted effect site concentrations (Fb) predicted by both the compartmental and physiologic models compared with the Lu data could be due to the use of a normal cardiac output for the simulation. Under anesthesia the cardiac output and the cerebral blood flow are low in the cardiac patients for CABG surgery.

The Gas Man derived compartmental model has to be used with caution when predicting effect site concentrations of desflurane.

References

- 1 Lu et al. Anaesthesia 2004;59:216-21
- 2 Hendrickx et al. BMC Anesthesiology 2006, 6:7
- 3 Varvel et al. J Pharmacokinet Biopharm 1992;20:63