Giving boluses of sedation- the good and the bad!

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Some boring science:

Sedative drugs are removed from the body by the liver and kidney. The rate of removal is almost always as a curve as shown in figure 1, this is an exponential function. The time taken for the drug concentration to fall by a half (↔) is the "half life" of the drug. The half life of Propofol is around 2 hours. This time is the same (2hrs) however high the initial concentration is.

When we start an infusion of a drug like the sedative drugs the concentration of the drug gradually rises until a steady state is reached. For complex reasons this time (↔) is around 4 to 5 half lives of the drug. This means that for Propofol with a 2 hour half life the concentration will not reach a steady sate until 8 to 10 hours after the rate of the infusion has been increased.

If we run the infusion at twice the rate then the eventual steady state will be twice as high but it will still take the same time to achieve it.

The next side shows how we can get around this problem.

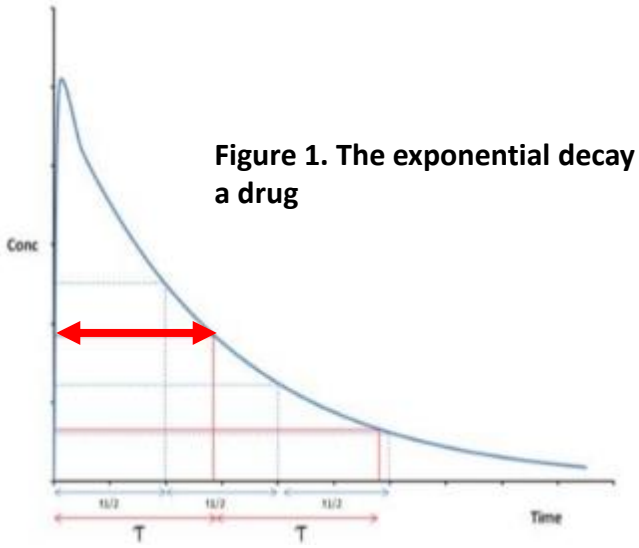


Figure 1. The exponential decay of a drug

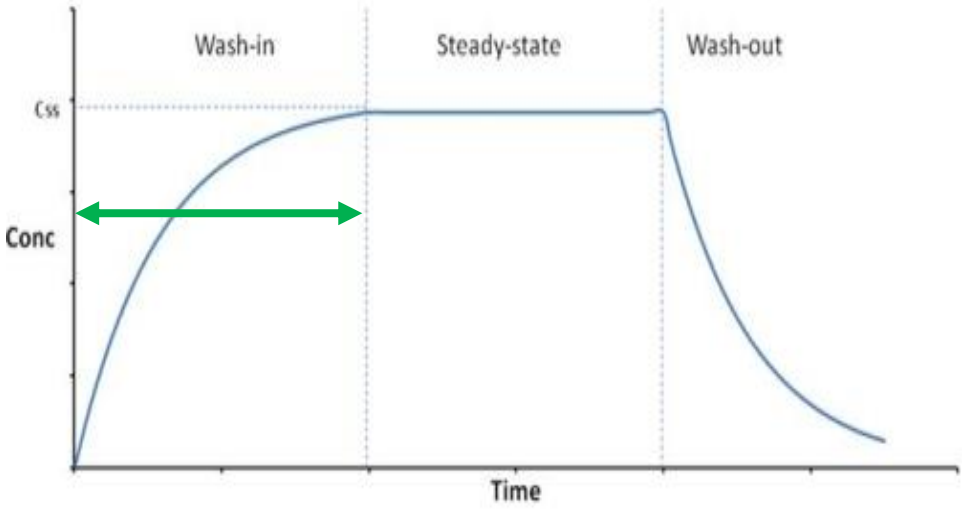


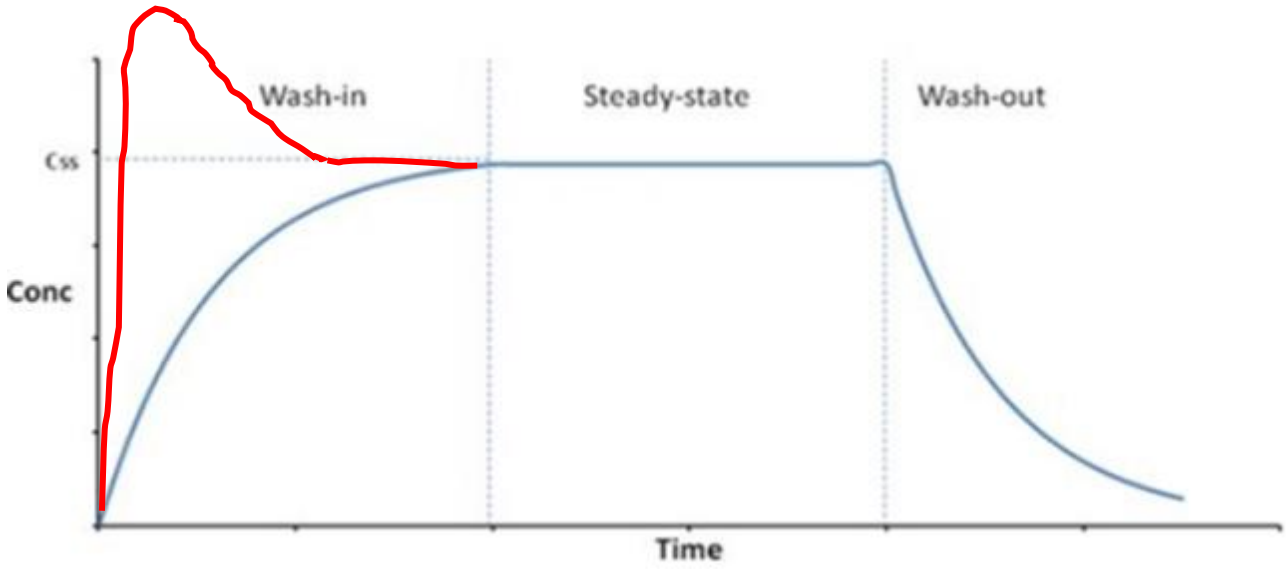
Figure 2. Changes in drug concentration of an infusion of a drug

How we can rapidly achieve a steady state of a sedative drug?

One way that we can do this is by giving a bolus of the drug at the same time as increasing the rate of infusion. The bolus will give an initial high concentration that will then be maintained by the infusion. In the figure below we have given a bolus that is a bit too much and the concentration has fallen a bit to the steady state.

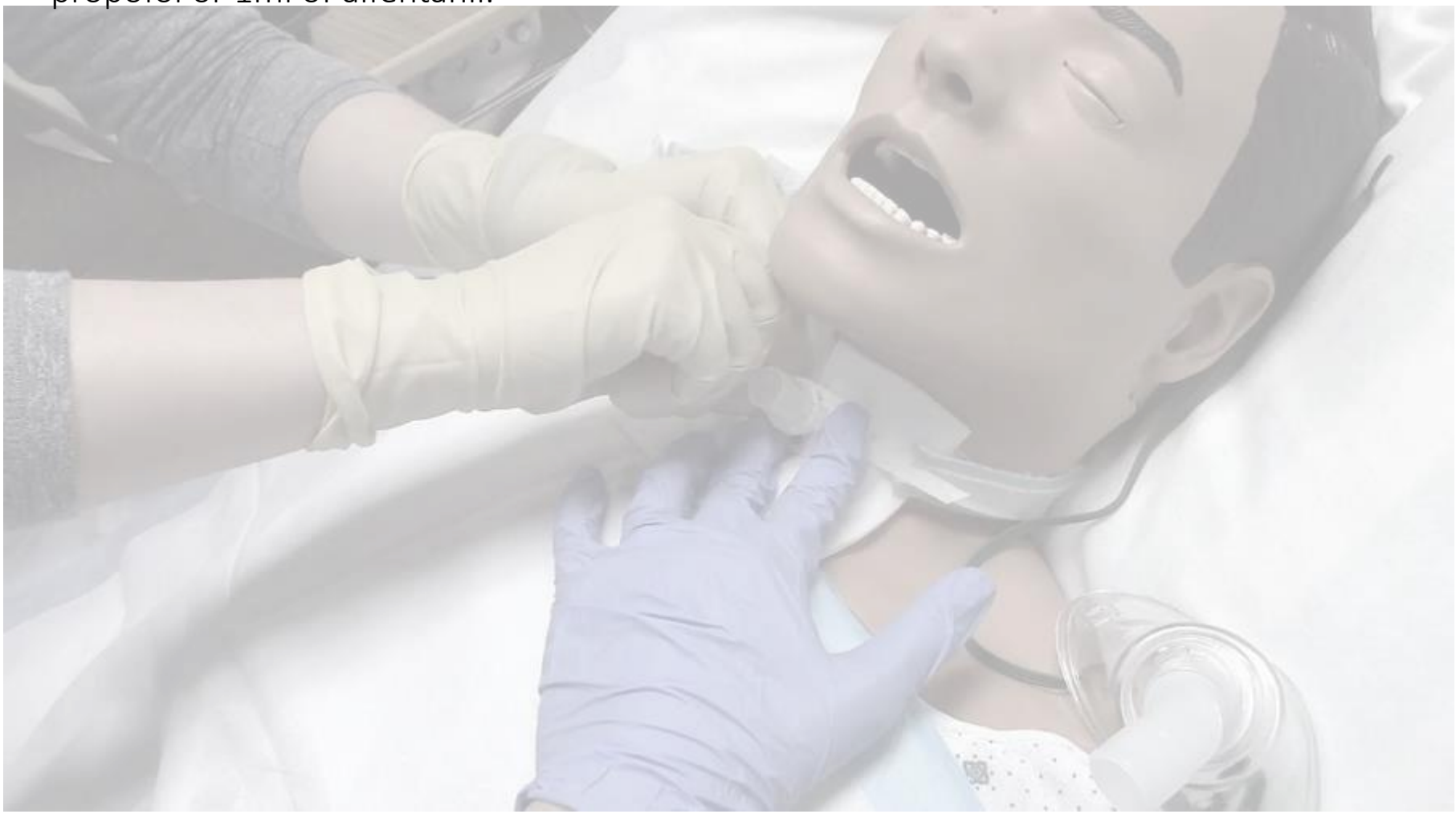
We could have achieved a similar steady state by increasing the rate of the infusion a lot at the start and then reducing it. This is sometimes done but it would still take longer to reach steady state and if we forgot to reduce the infusion then we would over dose the patient.

So one reason for giving a bolus is to rapidly achieve a steady state of the drug.



Changing needs for sedation and analgesia:

The need for sedation and analgesia changes a lot. For example patients may be upset by tracheal suctioning or other procedures like dressing changes or changing the patient's position. A bolus can be given in anticipation of these procedures while leaving a low background infusion that is enough to keep the patient comfortable when we are not doing things to them. Typical boluses are 1 to 2 ml propofol or 1ml of alfentanil.



Problems with bolus doses of sedative drugs

- The bolus may cause a temporary high concentration of the drug and this will cause side effects- most seriously stopping the patient from taking spontaneous breaths, particularly with Propofol or Alfentanil. If the patient is breathing spontaneously or triggering the ventilator *they may well stop breathing all together.*
- Many of these drugs may also cause *a significant drop in blood pressure or heart rate.*
- *Bolus doses add up and a patient may end up getting a lot of additional sedation.* This may well be because they need it to achieve their target sedation but it's important that this is recorded on observation chart so the doctors know. For example the total dose of Propofol may be putting the patient at serious risk or it may show that it's time to work out why the patient has such a high requirement or to add another drug.

How can we protect against these problems?

- We can give smaller bolus doses, particularly to small, old or frail patients.
- If the dose is not enough we can always give an additional bolus but we can’t take drugs out of a patient.
- We should be ready for the possibility that a patient may stop breathing or have a drop in BP and observe them closely and know what we would do to manage the problem, even if it’s just to call for help.
- We should record each bolus dose on the chart and let the doctors know if we are having to give a lot of additional doses.