Chapter 1

Why Bother?
The Advantages of TIVA

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Why Total Intravenous Anaesthesia?

Like many of you, we're sure, we were trained to use IV anaesthetic agents for induction of anaesthesia but inhalational for maintenance – a sensible and seemingly safe combination that has been used for decades. So why change? The initial attraction of TIVA was the extremely rapid, smooth and clear-headed recovery of patients when using propofol as the hypnotic component of an anaesthetic. This is particularly apparent when the drug is used for cases of short to intermediate duration, for example in day-case surgery with earlier discharge from the post-anaesthetic care unit.[1] Clearly in modern practice, which is moving towards shorter in-patient stays, this represents a major advantage. In addition, improved levels of patient satisfaction occur with TIVA, presumably due to the favourable recovery profile.[2] Certainly, desflurane and sevoflurane allow rapid recovery but it is not as smooth, there may be more emergence delirium and quality indicators are not as good.[3]

A study using psychomotor tests to compare the performance of volunteers at different blood alcohol concentrations with performance after anaesthesia with propofol and remifentanil, showed that about 40 minutes after TIVA, patients were sufficiently recovered to be able to drive in continental Europe with a blood alcohol concentration of 50 mg.100 ml^{-1} and after about one hour they were considered suitable to drive in Sweden with its lower legal alcohol level of 20 mg.100 ml^{-1}.[4]

There are many systems in the body that are affected adversely by inhalational anaesthetics; these include the lungs, liver, kidneys and heart. In addition, rare conditions such as malignant hyperthermia can be triggered in susceptible individuals by inhalation, but not by IV, agents. Neurotoxicity has also been reported in transgenic mice with the use of sevoflurane.[5] Inhalational anaesthetics have been assessed for use as sedatives in the intensive care unit (ICU) but were universally rejected because of concerns about toxicity.

Recently there has been considerable interest in the role of the peri-operative period in recurrence after cancer surgery and the influence of anaesthetic techniques.[6] A study examined long-term survival for patients undergoing inhalation versus IV anaesthesia for cancer surgery. The mortality was reported to be 50% greater with inhalation than with IV anaesthesia. Although this was retrospective data, propofol displays anti-tumour properties in both in vivo and in vitro laboratory settings, enhances cytotoxic T lymphocyte activity, inhibits cyclo-oxygenase (COX) in vitro[7] and hypoxia-inducible factor (HIF) 1-α activation.[8] Prospective research in this field is on-going.

Post-operative nausea and vomiting (PONV) has been considered a relatively unimportant consequence of anaesthesia but its occurrence has a significant impact on post-anaesthetic morbidity and increases overnight admission rates. For many patients it was reported as being a more unpleasant adverse effect than post-operative pain.[9] Propofol also reduces pain after surgery compared to inhalational anaesthesia.[10]

The final benefit of IV drugs is that this will be the future course of development of all new agents. New anaesthetic drugs will be developed at the molecular level, rather than relying on serendipity, and will be administered intravenously. TIVA and therefore TCI are likely to be the future for anaesthesia.

So If TIVA Is So Good Why Aren't More People Using It?

We too were interested in knowing why more people aren't using TIVA – although we had our theories.[11] Given our bias, we performed a study to collect objective data. We surveyed an international audience of anaesthetists[12] and divided the respondents into

Table 1.1 Reasons for not choosing to use TIVA on a particular occasion. Values are the number of respondents considering the respective reasons 'extremely important' or 'very important' over the total number of recipients in that group (%). Modified from Wong et al.[12]

Reasons for *not* using TIVA	Infrequent users (<5%) (n = 315)	Intermediate users (5–50%) (n = 323)	Frequent users (>50%) (n = 124)
Additional effort	164 (52%)	48 (15%)	17 (14%)
Lack of real-time monitor of propofol concentration	127 (40%)	56 (17%)	5 (4%)
Risk of missing drug delivery failure	108 (34%)	16 (5%)	5 (4%)
Institutional preference	106 (34%)	34 (11%)	14 (11%)
IV access invisible or inaccessible	104 (33%)	21 (7%)	4 (3%)
Increase turnover time	99 (31%)	25 (8%)	2 (2%)
Volatile is better	96 (30%)	29 (9%)	7 (6%)
Large inter-patient variability in dose requirements	93 (30%)	57 (18%)	9 (7%)
Difficult to predict wake-up	93 (30%)	23 (7%)	6 (5%)
Unavailability of depth-of-anaesthesia monitoring	91 (29%)	25 (8%)	9 (7%)
Additional expense	89 (28%)	25 (8%)	2 (2%)
Difficult to titrate doses to clinical needs	77 (25%)	47 (15%)	7 (6%)
No outcome benefits with TIVA	74 (24%)	113 (35%)	14 (11%)
Increased incidence of awareness	69 (22%)	27 (8%)	2 (2%)
Unavailability of TCI pumps	68 (22%)	43 (13%)	4 (3%)
Pharmacokinetic models not accurate	54 (17%)	56 (17%)	8 (6%)
Greater likelihood of cardiovascular instability	54 (17%)	91 (28%)	27 (22%)
Difficulty in titrating analgesia on emergence	53 (17%)	76 (24%)	12 (10%)
Creates crowded conditions around patient	48 (15%)	48 (15%)	3 (2%)
Complicated pharmacokinetic models	48 (15%)	79 (24%)	16 (13%)
Long induction time	44 (14%)	69 (21%)	7 (6%)
Difficult IV access	42 (13%)	94 (29%)	27 (22%)
Unavailability of non-reflux/one-way valves	38 (12%)	50 (15%)	11 (9%)
Insufficient training in the use of TIVA	34 (11%)	62 (19%)	30 (24%)

three groups depending on their frequency of TIVA usage. Infrequent users are those using TIVA for less than 5% of cases; those who use TIVA more than 50% of the time were designated as frequent users; while those using between 5 and 50% were considered intermediate users. We asked them to consider a list of factors and indicate whether they thought each was extremely, very, moderately, not very or not at all important to their decision for *not* choosing to use TIVA on a particular occasion. Table 1.1 summarises some of the findings.

We refer the readers to the paper for detailed discussion but several interesting points can be seen from a cursory look at the table. The most striking is the difference in the perception of importance to the same factor depending on how frequently one uses

TIVA. For example, presumably anaesthetists are aware of the difference in reported rate of accidental awareness under anaesthesia between inhalational and intravenous techniques. Yet there is a ten-fold difference in the response of those who perceived it to be important depending on whether they were a frequent TIVA user or not. A similar observation is applicable to their perception of having a lack of real-time monitoring of propofol concentration. A second point is the importance of non-technical factors in their decision not to use TIVA, with 'additional effort', 'institutional preference' and 'increased turnover time' ranked high on the list. Interestingly, a contemporaneous survey to ours of 1000 anaesthetists from the Australian and New Zealand College of Anaesthetists,[13] 18% of whom use TIVA in the majority of cases, indicated that 41% would use TIVA more often if set-up were easier.

What do we conclude from all this? We think that non-technical factors play a significant role in our choice to use TIVA or not and decisions are not only based on 'evidence'. An example is the testimony of Dr Nick Sutcliffe, the author of Chapter 8, whose conversion to TIVA enthusiast was based on an entirely different motivation. As seen in the next section, rather than being deterred by the additional effort, Nick was in fact motivated by the excitement of using more thought and effort!

So Tell Me Again, Why Bother?

In most people's anaesthetic career, there will come a time when one will have to use TIVA – like it or not, this is an essential skill for the modern anaesthetist. If your patients are immune to PONV or malignant hyperthermia, or do not require surgery for cancer, or it is always technically possible to use the inhalational route, then you may be a little less motivated to develop and maintain competency in TIVA. However, for the rest of us: will you be confident when required to use TIVA? Murphy's Law would probably have it that such occasions occur in less than optimal circumstances. Intuitively we know that we are more inclined to make errors when dealing with an unfamiliar technique and this may be a major reason why the incidence of accidental awareness is reported to be higher with TIVA. So, if not for any other reasons than for patient safety, you should be competent and maintain competency in TIVA by regular use and an understanding of the principles.

Are there any drawbacks of TIVA? Of course! At present, we do not have a reliable and convenient way of detecting disconnection or non-delivery of the drug, although research and technology is always advancing. With practice, vigilance and following the tips and tricks outlined in this text, drawbacks can be reduced and you should feel completely comfortable with this technique.

Humankind has always struggled, and will continue to struggle, with the problem of not doing something despite knowing it is 'good'. An example is the simple health advice of consuming fewer calories and exercising more. Most people in the affluent world know that this is good advice and yet how many people follow that consistently? There are a multitude of benefits with TIVA. If you were a patient, would you want your anaesthetist to make the effort and use a technique that would confer these benefits? If so, don't you owe it to your patients to do the same?

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