Research Article

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A Survey on the Use of Smart Drug Delivery System (Tci) for Total Intravenous Anaesthesia (Tiva) Among Indian Anaesthesiologist

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Abstract

Introduction: In the conventional drug delivery is the absorption of the drug across a biological membrane. The targeted (smart) drug delivery is a method of delivering medication to a patient in a manner that increases the concentration of the medication in some parts of the body relative to others.

The use of Total Intravenous Anaesthesia (TIVA) has been growing worldwide over the last 2 decades due to the creation of new drugs and the development of new smart drug delivery system Target-controlled Infusion (TCI) pumps, the use of TIVA has not been expanded yet as part of routine practice.

Aim: To determine the frequency of usage of TCI for TIVA and to identify limitation by the respondents for the adoption of this type of anesthesia technique.

Materials and methods: Google Survey designed to determine the use of TCI for TIVA in anaesthesia practice in India. Results analyzed and reported.

Results: Out of 450 randomly selected anaesthetists152 (33.77%) responded from metro cities and were practicing or medical academics. Out of which 106 (69.5%) persons preferred to use TIVA versus inhalation anaesthesia. For question on manual versus automated infusion for the use of TIVA 108 persons were using manual infusion. For question on the use of TCI device for TIVA only 12.1 % were using rest 87.9% were not using TCI, though of these 82.9% preferred to use TCI. Non availability, non-familiarity, lack of experience or knowledge among anesthetists, limited servicing facility or cost were the major concerns for not using TIVA.

Conclusions: from the above survey we can conclude that majority of the participants are not using TCI pumps but recommends to implement TCI pumps in their TIVA practice in India. Its adoption is hinder by high cost of equipment, fear of awareness during anaesthesia, Non availability of drugs and equipment's.

Introduction

Total Intravenous Anaesthesia (TIVA) is a method of general anaesthesia which uses a combination of anaesthetic drugs given by the intravenous route without the use of inhalation agents (Gas Anaesthesia) [1]. As the inhalation agents produces atmospheric pollution greenhouse effect and is the biggest problem of the world. Effect of all inhalation agents belongs to CFC group chlorofluorocarbons which contain chlorine. They are believed to have significant ozone (O_3) depleting potential. N_2O is very stable and has a life expectancy of 150 years.

The use of total intravenous anaesthesia has been growing worldwide over past 2 decades due to the creation of new drugs and better understanding of the pharmacokinetic and pharmacodynamic properties of drugs such as Propofol and newer short-acting opioids, pharmacokinetics of intravenous anaesthetic drugs and advances in the technology which allow the use of algorithms leads the development of smart drug delivery system Target-Controlled Infusion (TCI) pump [2].

TIVA is useful for high risk patients having other advantages like the less atmospheric pollution, negligible cardiovascular depression, low neurohumoral response, less incidence postoperative nausea and vomiting, early and predictable recovery leading to earlier discharge in outpatient surgery, less postoperative agitation [3]. Moreover, TIVA does not require a sophisticated device for delivering anaesthetic gases or waste gas extraction systems[4], TIVA requires a safe venous line, it takes less time than regional techniques [5].

With the use of TIVA Intermittent boluses of agents or manually controlled infusions may produce an inadequate effect. Poor understanding of the pharmacokinetics of target-controlled infusion (TCI)/ TIVA practice has contributed to accidental anaesthetic awareness as reported by NAP5 [6].

TCI pumps achieves a targeted plasma concentration with a loading dose based on its initial volume of distribution and targeted plasma concentration which follows decreasing rate of infusion based on drug distribution in peripheral compartments as well as metabolism and excretion. So, it maintains targeted plasma concentration and level of anaesthetic depth [7].

Though there are various benefits, current anaesthesia practice is still dominated by balanced anaesthesia, which combines the use of inhaled agents with intravenous opioids. The choice of one technique over another depends on the anaesthetist's personal experience, patient variables and the availability of supplies and equipment in the work setting [8].

On literature search for the use of TIVA limitations include the lack of devices like infusion pumps in the workplace, costs, the non-avail-

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ability of adequate intra-venous drugs, the difficulty in determining the anaesthetic plane, and the lack of education and training for performing the TIVA technique[9,10].

The aim of the study was to see the use of TCI for total intravenous anaesthesia in our country India, to identify existing barriers for its usage and also to see the main indications and the limitations identified by the respondents for the adoption of this type of anaesthesia technique.

Materials and Methods

We did a Cross sectional cohort study using an on-line questionnaire sent out to a group of active anaesthetics practicing in India using google forms in order to optimize the response rate survey was developed on the basis of 9 specific questions on the use of TIVA anaesthesia as shown in Annexure 1, requiring less than 5 min to complete, follow-up phone calls were used to contact the anaesthetics who did not respond to the initial on-line survey, in order to increase the number of responses. All the participants agreed to the surveyvoluntarily and freely. Any form of financial or material incentive not received by the responder for participate in survey. The survey was done over a period of 5 months from November 2018 to March 2019 with the help of google forms in the form of simple questionnaire. All the questionnaires were statistical analyzed by google search survey and results were recorded. Inclusion criteria was a qualified anaesthesiologist who is currently practicing in India while the exclusion criteria includes anaesthesiologist who are qualified from Indian university but not currently practicing in India and anaesthesiologist outside India and anaesthesiologist who didn't answer more than 70% of questions.

Annexure 1
1) Where do you practice? Government Medical college Private medical college Government hospital Corporate hospital Freelance anaesthesiologist
2) Which is your place of work? City Town Rural area / others
3) Which is your preferred mode for general anaesthesia? Inhalational TIVA Both
4) What devices do you use for TIVA? Intermittent Bolus Macro-drip set Volumetric pump TCI
5) Do you use TCI pumps in your TIVA practice? Yes No
6) Do you recommend TCI use for TIVA? Yes No
7) Which is your drug of choice for TIVA? Propofol Ketamine dexmedetomidine Others / combination of two or three drugs
8) Which is your preffered mode of monitoring while performing TIVA? BIS monitoring EEG monitoring Both

Results

Out of 450 randomly selected anaesthetists, 152 (33.77%) responded. We had tried to match the place of work and the usage of TIVA among the Indian anaesthetist. Among the 152 participants 32.9 %works in government medical college, 5.5% works in private medical college, 37.0% works as freelance anaesthetist, 19.2% works in corporate hospital and 5.5% works in government hospital. Out of all the respondents 84.31% works in cities whereas 13.73% works in town hospitals. The main indications considered by the participants for the use of TIVA were day care surgery 128 (63.4%), second main indications were tubeless ENT surgery 37 (18.3%) all other indication like neurosurgery and cardiothoracic surgery shown in figure 1.

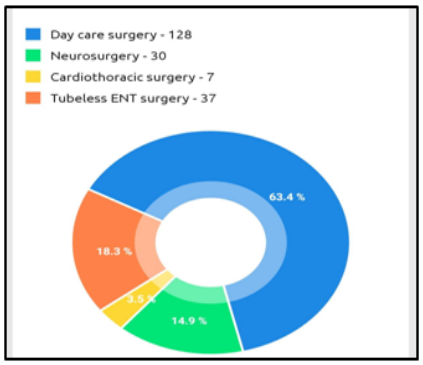

Figure 1: Indications for TIVA among the anaesthesiologist surveyed.

Most of the participants (71.1%) routinely practice both TIVA and Inhalational anaesthesia techniques in their routine practice, while 19.7% prefer only inhalational anaesthesia and only 9.15% prefer TIVA in their routine practice. As shown in figure 2.

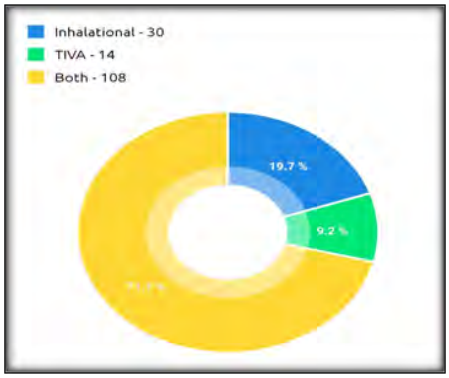

Figure 2: Preferred mode of GA by participants.

As a whole 49% of the participants were using manual infusion technique like intermittent bolus 16.1%, macro drip 32.9% while 38.9% of the participantswere using volumetric infusion pumps. Only 12.1% were using TCI pumps in their routine practice is described in Table 1.

As the important part of the survey question on the use of TCI device for TIVA only 12.1 % were using rest 87.9% were not using TCI, though of these 82.9% recommend and preferred to use TCI for TIVA practice only a minor portion of 17.1% participants doesn't consider that TCI pumps are essential for TIVA practice is described in figure 3A, 3B respectively.

Devices used	Number	Percentage
Intermittent bolus	24	16.1
Macrodrip set	49	32.9
Volumetric pump	58	38.9
TCI	18	12.1

Table 3: Devices used for TIVA among the anaesthesiologist surveyed.

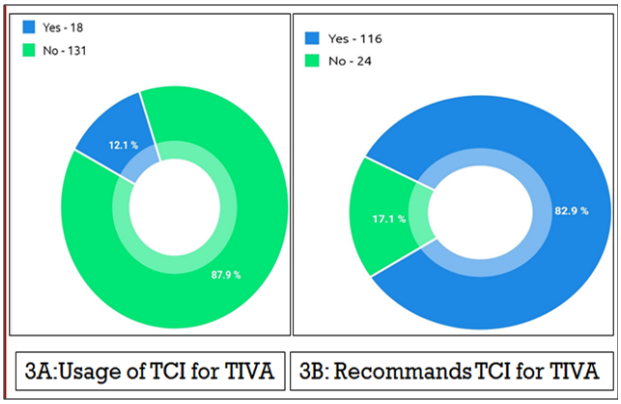

Figure 3: Usage and Recommendation of TCI for TIVA among the anaesthesiologist surveyed.

Regarding the drug of choice is propofol as 29.0% prefer to use propofol, but majority 52.9% prefer to use the combination of two or three drugs for TIVA. While 10.41% prefers ketamine and 7.7% prefers other or dexmedetomidine as shown in table 2.

Drugs used for TIVA	Number	Percentage
Propofol	64	29
Ketamine	23	10.4
Dexmeditomidine/opioids	17	7.7
Combination of two or more drugs	117	52.9

Monitoring the depth of anaesthesia is important component of general anaesthesia to prevent awareness. We have asked questions regarding the preferences of monitoring devices and the responses were like 40.52% were using BIS monitoring, 3.27 % were using EEG monitoring, 22.88% prefer other modes of monitoring and 33.33% didn't answer the question.

The reasons identified for not using TIVA /TCI included non-availability of monitors for depth of anaesthesia, infusion pumps, TCI pumps and drugs were 10.7 %, 9.3%, 18.7% and 10.7% respectively. Most of the responders didn't prefer TIVA due to higher cost (21.3%) and fear of awareness (16.0 %) while due to lack of experience 8.0 % not using TIVA. Other causes for not using TIVA were only 5.3% as shown in figure 4.

Discussion

Total Intravenous Anaesthesia (TIVA) has become more popular due to rising environmental concerns, availability of newer shorter-acting anaesthetic drugs, and is supported by the advent of computerized Drug Delivery Systems (DDS)[11]. Research in newer DDS is being carried out in liposomes, nanoparticles, niosomes, transdermal drug delivery, implants, microencapsulation, and polymers.

TCI pumps drug delivery is based on bolus elimination and transfer principle[12]. TCI strongly influences the development of intravenous anaesthesia and opens a scenario of new and exciting applications in perioperative anaesthetic management. TCI is a standardized infusion system for the administration of opioids, propofol and other anaesthetics by target controlled infusion [13].TCI technology is becoming a part of routine anaesthesia technique for the practitioner rather than a research tool for specialists and those who are enthusiasts of intravenous anaesthesia [14].

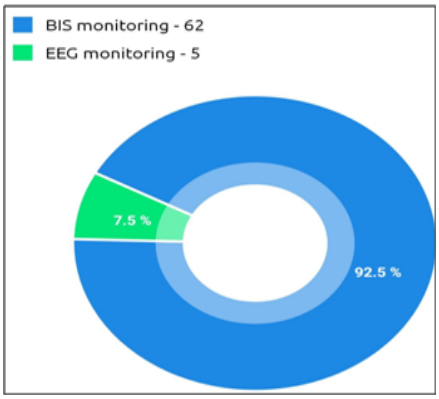

Figure 4: Monitors used for TIVA among surveyed anaesthesiologist.

Growing worldwide over the past 20 years due to the creation of new drugs and the development of new target-controlled infusion pumps, however the use of TIVA has not been expanded yet as part of routine practice among the different regions of the world particularly due to limited financial resources. The aim of this study was to see the use of total intravenous anaesthesia in our country India, to identify existing barriers for its usage and also to see the main indications and the limitations identified by the respondents for the adoption of this type of anaesthesia technique.

In spite of India having world's second largest population there are very limited Indian PK/PD data of anaestheticdrugs. On literature search there are various studies shows advantages of TCI and total intravenous anaesthesia [15-17]. But there are very few articles on use of TCI for Indian population. Article from IJA by Puri GD [18] concluded that it's high time for Indian anaesthesiologists to work on the pk/pd front to generate local data and their own pk models so as to use the drugs more efficiently. The Indian research funding agencies, as well aspharmaceutical industry, should come forward to support such studies, for the evolution of research in the field, which is the need of the hour. Many advantages of the intravenous anaesthesia technique have been described and, at present, there are clear indications and recommendation described in the literature for the use of TIVA in paediatric as well as adult patients [19].

This survey results found that the main indications considered by the participants for the use of TIVA were day care surgery 128 (63.4%), second main indications were tubeless ENT surgery 37 (18.3%).

There are various methods for the administration of TIVA like Target Controlled Infusion (TCI) pumps which are sophisticated infusion pumps works on effector site concentration control, volumetric pumps works on simulators that use pharmacokinetic models to calculate individualized doses for each patient, and for a simpler form of TIVA administration is manual infusion techniques that do not required additional devices or technologies. Many of this system are available in our country. This study reveals that 49% of the participants were using manual infusion technique, while 38.9% of the participants were using volumetric infusion pumps. Only 12.1% were using TCI pumps

in their routine practice. As the important part of the survey we asked the participants to mention the usage of TCI pumps for TIVA in their routine practice and theresult were 87.9% does not involve TCI pumps in their TIVA practice, while 12.1% uses TCI pumps. But surprisingly 82.9% participants recommend TCI pumps for TIVA practice and only a minor portion of 17.1% participants doesn't consider that TCI pumps are essential for TIVA practice.

The main limitations identified in this study group of respondents which discourage the use of TIVA in routine practice include the lack of infusion pumps, the lack of monitoring of the depth of anaesthesia, the lack of expertise in the use of TIVA, the non- availability of drugs.

Besides these reasons, most of the participants (71.1%) routinely practice balanced anaesthesia both combining TIVA and Inhalational anaesthesia techniques in their routine practice, while 19.7% prefer only inhalational anaesthesia and only 9.15% prefer TIVA in their routine practice. This is so because many practitioners are more familiar with this type of anaesthesia the lack of confidence to perform TIVA technique.

Interestingly many anaesthetists believe that the use of TIVA requires costly technology which increases the cost of anaesthesia. They also reported on the absolute need to have TCI pumps. However, it has been shown that manual infusion techniques are as effective and reliable as techniques that use TCI pumps, and provide similar anaesthesia quality and no events of intra-operative recall. A survey conducted in the United Kingdom revealed that only 38% of the anaesthetists used TCI pumps, despite their being readily available[20].Similar results were found by the study conducted in Colombia revealed that anaesthetists use mainly volumetric pumps for TIVA administration (53.9%), TCI pumps (31.9%)[21].

Clinicians in our study often quote awareness as the reason for avoiding TIVA, although evidence to support this view is very limited, and so that they recommended monitoring of the depth of anaesthesia as prerequisites for administering intravenous anaesthesia. Study of Z alrifidi et al also concluded poor education and training in the use of this technique is likely to result in a significant risk of awareness [22].

NAP5 emphasized a processed EEG device when administering TIVA is particularly necessary in patients who require neuromuscular paralysis. The report recommended that 'the relevant anaesthetic organisations should establish a set of standards and recommendations for best practice in the use of TIVA'.6 Key points given in guidelines for all anaesthetists to deliver TIV Acompetently and safely were titration of effect-site concentration to patient response is vital a processed EEG device is indicated principally for the prevention of excessive hypnosis. Awareness occurs with TIVA when technical failure prevents the administration of appropriate drugs vigilance for such errors is essential [23].

A similar study was conducted in Brazil in 2006 to assess the use of TIVA by means of a survey with the aim of the study was to assess "attitudes" of the respondents towards the technique [24]. The respondents from this study reported a desire to learn and perform TIVA techniques in their routine practice. They also reported that the availability of BIS monitoring for the depth of anaesthesia would increase the use of TIVA. It is important to gain adequate knowledge of pharmacology and pharmacokinetics as the scientific basis for performing the technique safely and predictably, and also as the basis for new research in the area and for the future development of new technologies and pharmacokinetic models.

Our study results for question regards to reasons for not using TIVA are same as that of National survey of Colombian anaesthetists. They concluded that the use of TIVA has been limited by the low availability of technology, lack of experience or knowledge among anaesthetists, and a preference for the balanced anaesthesia technique. Many anaesthesiologists prefer balanced techniques for general anaesthesia. Some devices used for TIVA administration raise concerns about patient safety [21].

Conclusion

From the above survey we can come to a conclusion that majority of the participants are not using TCI pumps in the routine practice but recommends to implement TCI pumps in their TIVA practice. We Indian anaesthesiologist are interested to adopt TCI technology.However, its adoption is hinder by high cost of equipment, fear of awareness during anaesthesia, and consequently lack of availability or servicing facility of the equipment.

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