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Original Article / Özgün Araştırma

Anaesthetic Drug Choices of Senior Anaesthetists: An Observational Analysis of Medication Habits in a Tertiary Hospital

Kıdemli Anestezistlerin Anestetik İlaç Seçimleri: Üçüncü Basamak Bir Hastanede Medikasyon Alışkanlıklarının Gözlemsel Bir Analizi

Laura Münst[1], Martin Schläpfer[2], Peter Biro[3]
[1]*Department of Internal Medicine, Spital Zollikerberg, Zollikerberg, Switzerland*
[2]*Institute of Physiology and Institute of Anesthesiology, University Hospital Zurich, Zurich, Switzerland*
[3]*Institute of Anesthesiology, University Hospital Zurich, Zurich, Switzerland*

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ORCID IDs of the authors: P.B. : 0000-0002-2855-4991; M.S. 0000-0003-4288-7124.

Abstract / Öz

Objective: Various drugs are available for general anaesthesia, and the anaesthesiologist in charge may choose the one that is considered as the most appropriate for each specific case. When selecting an anaesthetic drug, its specific pharmacokinetic and pharmacodynamics as well as certain non-pharmacological properties have to be considered. This may lead to decisions that may be justified or unjustified according to scientific evidence and local standards.

Methods: In a prospective, single-centre, non-randomised and non-interventional study, 30 attending anaesthetists were interviewed about their drug prescription for general anaesthesia cases scheduled for the next day. The stated reasons for their choices from available alternatives were recorded and analysed for being justified or unjustified.

Results: We found 69% of all decisions as justified, while 31% were incorrect, unjustified or random. Female anaesthetists made 83%±15% justified decisions, whereas males achieved a lower performance with 69%±17% justified decisions (p=0.046).

Conclusion: To a large proportion, convenience, habit and personal preferences influence the decision-making in choosing the anaesthetic medication. A change of paradigm in the postgraduate education and training seems to be necessary.

Keywords: Anaesthetic drugs, decision making, practice standards, postgraduate education.

Amaç: Genel anestezi için çeşitli ilaçlar mevcuttur ve sorumlu anestezist her bir spesifik vaka için en uygun olanı seçebilir. Anestetik bir ilaç seçerken, diğer özelliklerinin yanı sıra spesifik farmakokinetik ve farmakodinamik özellikler de düşünülmelidir. Bu durum, bilimsel kanıtlara ve lokal standartlara göre gerekçeli ya da gerekçesiz olabilecek kararlara neden olabilir.

Yöntemler: Bu prospektif, tek merkezli, randomize olmayan ve girişimsel olmayan çalışmada, bir sonraki gün için planlanan genel anestezi vakaları için ilaç reçeteleme hakkında 30 anestezist ile görüşme yapıldı. Mevcut seçenekler arasından yaptıkları seçimler için belirttikleri nedenler kaydedildi ve gerekçeli ya da gerekçesiz olmaları yönünden değerlendirildi.

Bulgular: Bu kararlardan %69'u gerekçeli bulunurken, %31'i yanlış, gerekçesiz veya gelişigüzeldi. Kadın anestezistler %83±%15 oranında gerekçeli kararlar verirken, erkek anestezistler %69±%17 oranıyla daha düşük bir performans gösterdiler (p=0,046).

Sonuç: Uygunluk, alışkanlık ve kişisel tercihler anestetik ilacın seçiminde karar verme sürecini büyük ölçüde etkiler. Lisansüstü eğitimde paradigma değişikliğine ihtiyaç olduğu görülmektedir.

Anahtar Kelimeler: Anestezik ilaçlar, karar verme, uygulama standartları, lisansüstü eğitim

Introduction

When planning an individual case for anaesthesia, we have the choice between various well-established, tested methods and drugs. Contraindications might prohibit the use of certain drugs in special cases, while usually an alternative of the same category might be suitable. Examples of such absolute contraindications are trigger substances in patients susceptible for malignant hyperthermia or barbiturates in patients with hepatic porphyria. However, in a vast majority of cases, there is ample room for choosing a drug vs its alternatives of the same category. It is interesting to know what causes the decision in favour of a certain drug vs its established alternatives.

Drugs of the same category may have certain differences in their pharmacokinetic and pharmacodynamic properties (1-3), which in turn may influence the choice for a certain drug against the available alternatives, albeit the medical indications may largely overlap. However, there are many other reasons in favour of certain drug, such as local tradition, economic

Corresponding Author / Sorumlu Yazar: Peter Biro E-mail: peter.biro@usz.ch
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Table 1. Main justified arguments for favouring an anaesthetic drug against its alternative that were used for the assessment of the anaesthetists' answers during the interview

	Drug choice	Justified arguments
Induction i.v.-hypnotics (propofol vs thiopental)	Favouring propofol	PONV history
	Favouring thiopental	Rapid sequence induction, polytoxicomania
Volatile anaesthetics for maintenance (sevoflurane vs desflurane)	Favouring sevoflurane	Obstructive pneumopathy, laryngeal mask
	Favouring desflurane	Renal disorder, obesity
Neuromuscular blocking drugs (rocuronium vs atracurium)	Favouring atracurium	Renal disorder
	Favouring rocuronium	Permanent blockade necessary and reversal with sugammadex planned
Opioid strategy for maintenance (fentanyl alone vs fentanyl/ remifentanil combination)	Favouring fentanyl alone	Postoperative prolongation of analgesia required
	Favouring a fentanyl/remifentanil combination	Rapid transition to spontaneous ventilation required

PONV: postoperative nausea and vomiting.

reasons, logistic circumstances or simply personal preference of the person who plans the upcoming anaesthesia (2, 4-7). From this large spectrum of possible decisions, we distinguish choices for a certain drug that are based on locally accepted standards vs unfounded alternatives, which however may be still acceptable from a strict medical point of view.

To illuminate this still rather obscure field of drug-related decision-making, we decided to interview attending anaesthetists from our anaesthesia department on their individual choices based on the existing cases scheduled for the following day, while carefully avoiding a biasing effect due to the interview itself. We categorised the decisions as justified or unjustified according to accepted pharmacological knowledge and logistic conditions in our department.

Methods

In this prospective, approved (Cantonal Ethics Committee, KEK-ZH 2015-0539, chaired by Peter Meier-Abt, issued on 18.8.2016), single-centre, non-randomised study, we interviewed all senior anaesthetists from the anaesthesia department, which belongs to a tertiary, academic hospital, after they concluded the planning for the following days' elective cases. These were 30 board-certified attending anaesthesiologists who provided written consent to be interviewed on cases they have individually dealt with. They were addressed face-to-face while viewing their finalised prescription for the discussed cases of the following day. The personal interview was not declared in advance to not influence the subjects' anaesthetic decisions by the questions. Their previous decisions for or against anaesthetic drugs for adult patients (aged >18 years) undergoing elective general anaesthesia were documented, as well as the stated reasons for their decisions. One interviewee dropped out. Each interview lasted approximately 15 min. Data saturation was not an issue, as the study involved 30 board-certified attending anaesthesiologists of the university hospital. The researcher's interest in the topic was communicated.

Table 2. Overview of all drug choices by category. Number of choices (percentage inside the respective drug pairs)

Drug pairs (n)	Drug choice	Decisions n (%)	Justified decisions (%)
Propofol vs thiopental (30)	Favouring propofol	27 (90)	66
	Favouring thiopental	3 (10)	
Sevoflurane vs desflurane (14)	Favouring sevoflurane	12 (86)	71
	Favouring desflurane	2 (14)	
Rocuronium vs atracurium (25)	Favouring atracurium	19 (73)	55
	Favouring rocuronium	7 (27)	
Fentanyl alone vs fentanyl/ remifentanil combination (30)	Favouring fentanyl alone	9 (30)	86
	Favouring a fentanyl/ remifentanil combination	21 (70)	
All pairs	All choices	99	69

The standardised questionnaire comprised of questions related to four pairs of commonly prescribed anaesthesia drugs of the same category, which could be chosen alternatively. Each case could comprise multiple decision pairs. The stated reasons for their choices by the interviewed senior anaesthetists were assessed after their decision-making and compared with a standardised list of justified and unjustified reasons (Table 1).

The reasons for choosing one of the two alternatives from each pair of alternative drugs, as indicated by the investigated anaesthesiologists, comprised pharmacokinetic and pharmacodynamic considerations, as well as miscellaneous non-pharmacological reasons such as availability, costs, local tradition and personal habit.

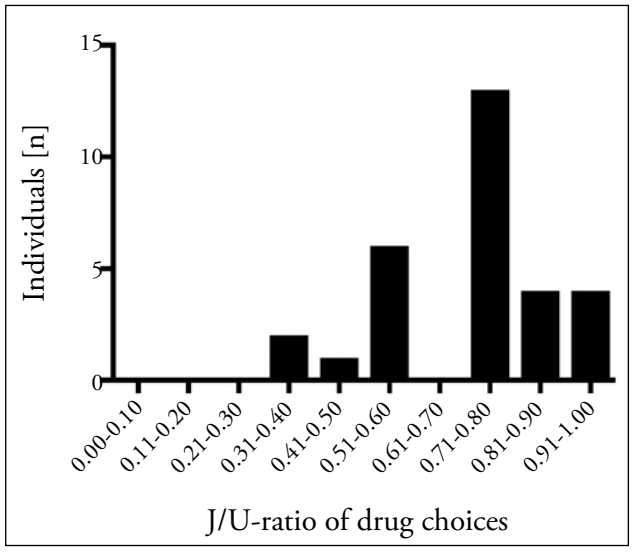

Figure 1. Number of decisions for drug choices made by senior anaesthetists and ratio of justified/unjustified decisions (J/U-ratio)

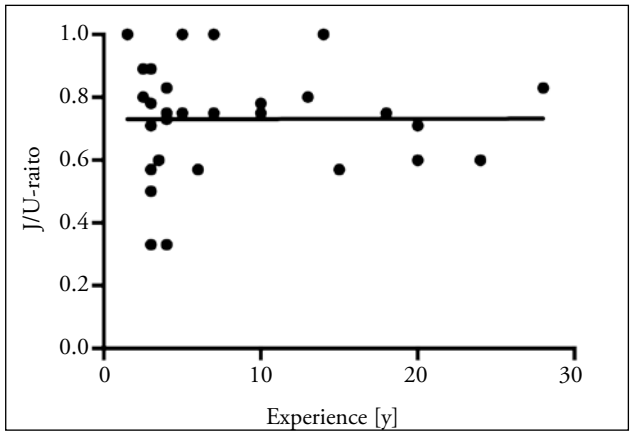

Figure 2. Linear regression of justified vs unjustified decisions (as J/U ratio) in correlation with the professional experience in years. We observed no correlation between professional experience and adherence to the locally adopted standards (J/U-ratio). The regression line describes almost a horizontal line with the equation: $y=0.0057*x+73.02$, $R2=5.7*10^{-6}$

At this point, we must emphasize that with 'unjustified' drug choices we do not mean a medical risk for the involved patients. The decisions labelled as 'unjustified' indicate certain non-vital disadvantages for the operating unit, e.g. longer duration for emergence from anaesthesia (by choosing a drug with a less favourable pharmacokinetic profile). Choosing a drug with a less favourable pharmacodynamic profile would eventually cause less haemodynamic stability and the necessity of corrective measures. Finally, if a drug choice was unfavourable for non-pharmacological (e.g. logistic) reasons, it might delayed the operating room schedule. The qualitative aspects of this study were assured by using the consolidated criteria for reporting qualitative research checklist (8).

Biometric and clinical details of the patients in the investigated cases were recorded to evaluate the appropriateness of

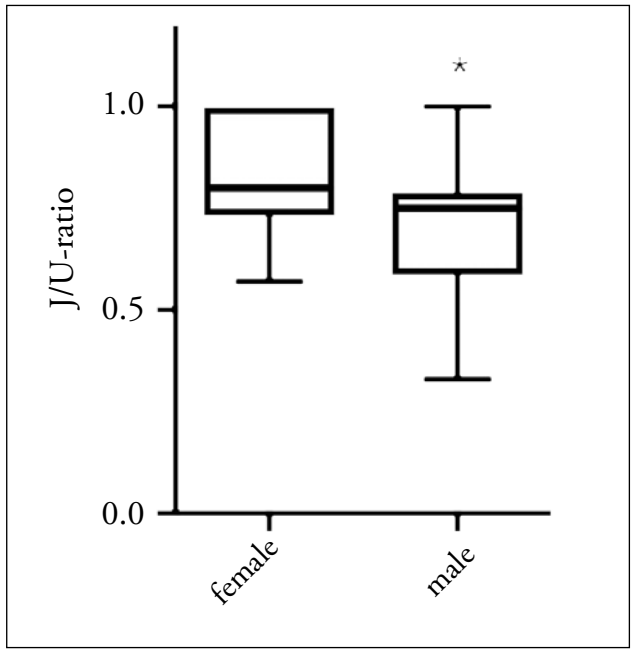

Figure 3. Comparison of justified/unjustified (J/U) ratio from male vs female senior anaesthesiologists presented as boxplots (25%-75% percentile, whiskers represent minimum and maximum values). Female senior anaesthesiologists had a significantly higher J/U-ratio indicating a closer adherence to the locally adopted standards compared to their male colleagues (*p=0.046).

pharmacological decisions. Age, gender and amount of professional experience (in years of activity) of the interviewed subjects were also documented.

Data were transferred into an Excel (Microsoft, Seattle) spreadsheet, which was also used for computing the descriptive statistics. Further calculations, statistical analyses and illustrations were performed in GraphPad Prism 6.0 (Graph Pad Incorporation, La Jolla, CA). Unless otherwise stated, data are presented as mean [±standard deviation (SD)]. Each subject's quality level for their decisions was displayed as the ratio of justified/unjustified decisions. A linear regression was made between the ratio of the justified/unjustified decisions on one hand and the duration of professional experience on the other. The percentage of justified decisions of male vs female participants and the number of decisions taken that passed the Shapiro-Wilks normality test were compared by a two-tailed Student's *t*-test; a p value of <0.05 was considered statistically significant.

Results

During the investigation period, we collected data from 30 attending anaesthetists of our department, who were involved in planning elective anaesthesia cases for the next day. We interviewed nine females and 21 males. The average age was 42.3 (±7.8) years ranging from 33 to 62 years, and the mean duration of professional experience as specialists was 8.4 (±7.3) years ranging from 1.5 to 28 years.

The involved anaesthetists made 99 choices from the available four drug pairs or medication alternatives (Table 2).

Overall, we found 69 justified and 30 unjustified pharmacologically and logistically inappropriate decisions, respectively. The lowest individual level of justified/unjustified ratio was 0.33 and the highest was 1.0 (Figure 1).

The number of justified decisions was not related to the duration of professional experience (Figure 2). However, there was a gender difference in favour of women (Figure 3). While the number of decisions per anaesthesia case taken by female anaesthetists was similar to their male colleagues [5.1 [±2.3] vs 6.1 [±2.3]; p=0.29], women made 83% justified decisions, whereas men showed a significantly lower performance in this regard with 69% (p=0.046).

Discussion

The sample size of 30 investigated colleagues was determined by the existing size of the staff and therefore represents the maximally possible number of interviews.We demonstrated that 69% of the anaesthetic drug choice decisions made by experienced attending anaesthesiologists were justified and in accordance with the generally accepted pharmacological knowledge, whereas the remainder of 31% were unjustified (albeit not representing medical risks for the involved patients). The ratio of justified/unjustified choices was independent of the professionals' level of experience. Only the scattering appears to be broader in younger health care professionals indicating a larger spread in pharmacological knowledge and its availability for application in clinical reality. Interestingly, female attending anaesthetists performed significantly better than their male peers. Determining the ratio of justified/unjustified choices was the major theme of the study; the secondary objective was to determine the difference in performance related to gender or professional experience.

Decisions concerning the induction of anaesthesia (propofol vs thiopental) were most frequent with a large predominance favouring propofol. These choices were appropriate in a majority of the cases (66%) (9-11). However, the remaining 34% of unjustified decisions is still worrying. Similarly, the neuromuscular blockers atracurium (favoured in 27%) vs rocuronium (favoured in 73%) were justifiably chosen in 55% (12, 13), while in 45% the decisions happened randomly. The choices for volatile anaesthetics resulted in a strongly asymmetric distribution favouring sevoflurane in 86% vs desflurane in 14%, which were justified in 71% (14-16). In particular, the strong preference of sevoflurane over desflurane was often due to a personal habit; however, economic arguments favouring sevoflurane are considered justified (5, 17-19). In the case of intraoperative opioid analgesia, there were in 30% decisions in the favour of fentanyl alone vs 70% for a combination of fentanyl/remifentanil, of which 86% were justified (20).

We expect that board-certified anaesthesiologists to plan their upcoming anaesthesia according to well-established and evidence-based considerations in accordance with the actual state of professional knowledge and appropriate medical care. A combination of well-founded pharmacokinetic, pharmacodynamic and non-pharmacological considerations should build the basis of such decisions. However, we observed that many decisions were based on personal habit, scientifically not substantiated preferences and ignorance or wrong information about the prevailing conditions of the patient and planned surgery. Most probably, unjustified choices may even have occurred randomly, as mentioned by other authors (1, 3, 21, 22). Fortunately, modern commonly used drugs in anaesthesia are very safe and have a broad range of indications. There are only few clear contraindications that are easy to be respected, and these were never contradicted by our staff members in the frame of this study.

An inappropriate pharmacokinetic consideration may for example result in a longer awakening period and reduced efficiency of the operation unit, which is not vital for an individual patient but is economically disadvantageous for the operative institution (23). An inappropriate pharmacodynamic choice may primarily affect the perioperative comfort of the patients and only rarely may cause morbidity, by eventually not preventing haemodynamic variations, as it would be with a more adequate drug choice (14, 22-25). Finally, inappropriate non-pharmacological considerations may have negative logistic or economic consequences (19).

A professional experience of up to 28 years had no impact on the appropriateness of the judgements. Remarkably, the nine females performed significantly better as compared to their 21 male peers.

The overall average of 31% unjustified and partially incorrect, inappropriate or randomly made drug-related choices is problematic. This seems to be even more worrisome considering that experienced personnel are entitled to decide on indications on their own, without consulting a superior. Leslie at al. found a comparable amount of unjustified decisions among anaesthetists and confirmed our finding that 'convenience and habit' are important factors in the choice of anaesthetics (2). Thus, it seems that there is still much room for pharmacological education and professional instruction, even in the experienced and educated subgroup of our colleagues. Another conclusion is that seemingly even professional expertise of several years does not improve the competence for scientifically sound and clinically justified decision-making.

Our investigation aimed to quantify unjustified drug choices for scientific and local logistic reasons, and we consider the percentage of 31% inappropriate decisions as noteworthy or even alarming from an educational point of view. Further investigation of postoperative outcome parameters due to pharmacological decisions was not the focus of this trial. However, even in the case of 'unjustified' decisions, there were no

medical complications or lasting changes to be expected. This aspect should be addressed in future investigations concerning clinical decision-making in anaesthesia on a broader scale.

There are a few limitations to our study. We present data from a single-centre with a limited number of participants, which was given by the size of the department. Our results may need to be confirmed in larger multicentre trials, but we are confident that our findings are comparable to other institutions and countries with similar postgraduate education systems. In addition, our study cannot exclude the non-logical factors influencing the subject's decision. The interview was conducted retrospectively to the investigated decision-making, but we consider the risk of a wrong recall as small, since the interviews were performed after the interviewed colleagues have concluded their anaesthesia plans for the next day. An essential strength of our study is that we interviewed the chosen anaesthesiologists after they had concluded their anaesthesia planning to ensure that the data collection itself did not influence the results. To obtain comparable data, we used a structured questionnaire and concentrated on a small but representative selection of alternative drug pairs.

Conclusion

To our knowledge, this is the first systematic clinical study on real-world pharmacological decision-making involving experienced attending anaesthesiologists, investigating the appropriateness of pharmacological and non-pharmacological considerations. We hope that our study will raise attention to this rather neglected topic and may encourage attending anaesthesiologists to accelerate self-education efforts. We consider our results to be a proof for the necessity of continuing education in pharmacology for anaesthesiologists, independent of their level of clinical experience.

Ethics Committee Approval: The study was approved by the Cantonal Ethics Committee, Zurich, Switzerland (chaired by Peter Meier-Abt) under the number KEK-ZH 2015-0539.

Informed Consent: Informed consent was obtained and the consent form was signed by each participant.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - P.B.; Design - P.B., M.S., L.M.; Supervision - P.B.; Materials - L.M.; Data Collection and/or Processing - M.D., L.M.; Analysis and/or Interpretation - P.B., M.D., M.S.; Literature Search - P.B., L.M., M.S.; Writing Manuscript - P.B.; Critical Review - P.B., L.M., M.S.

Conflict of Interest: L.M. has no competing interests. M.S. has received travel funding from Baxter Switzerland in the past, but unrelated to the current study. P.B. has received travel funding from Merck Sharp & Dohme in the past, but unrelated to the current study.

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Hasta Onamı: Bilgilendirilmiş onam her katılımcıdan alınmış ve onam formu her katılımcı tarafından imzalanmıştır.

Hakem Değerlendirmesi: Dış bağımsız.

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