STUDENTS' CORNER
RESEARCH ARTICLE

Assessing knowledge of dental house officers regarding dosage calculation and complications of local anaesthesia, in three tertiary care dental hospitals of DUHS, Karachi

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Abstract

Objective: To assess the knowledge and awareness of dental house officers regarding calculation of local anaesthesia dosage, and to evaluate differences in practices at various tertiary care facilities.

Method: The cross-sectional study was conducted at three dental hospitals affiliated with Dow University of Health Sciences, Karachi from July to December 2022, and comprised house officers of either gender currently enrolled at the participating centres. Data was collected using a self-administered questionnaire to assess knowledge and awareness of local anaesthesia dosage calculation, administration methods, and common complications. Data was analysed using SPSS 26.

Results: Of the 200 subjects approached, 136(68%) responded, and 89(65.4%) of them were females. Knowledge regarding the meaning of 2% lidocaine solution was low 45(33%), and 68(50%) subjects were knowledgeable about the maximum dosage of lidocaine with epinephrine. In terms of practice, lidocaine was the most commonly administered local anaesthetic 115(85%), followed by bupivacaine 15(11%). The majority of subjects administered local anaesthesia with vasoconstrictor 127(94%), but only 36(27%) performed aspiration during administration. Syncope 71(52%) was the most commonly reported complication, followed by lip/cheek/tongue biting by 35(26%).

Conclusion: House officers' knowledge level of local anaesthesia administration indicated the need for adequate training.

Keywords: Local anaesthetics, Knowledge, Lignocaine, Drug dosage calculation. (JPMA 74: 1397; 2024)

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Introduction

Anaesthetics are an essential component of modern dentistry, as they allow for the safe and comfortable execution of many procedures that would otherwise be too painful or uncomfortable for the patients. Local anaesthesia (LA) is the most commonly used type of anaesthesia in dental procedures because it provides targeted pain relief to a specific area of the mouth without affecting the patient's consciousness or respiratory function.[1] The anaesthetic solution is injected adjacent to the nerve supplying the area where the dental procedure is to be performed.[2] The most common method for administering LA is through an aspirating syringe.[3] The importance of these drugs is significant, and a study in Ontario reported that an average dentist administered more than 1,500 cartridges over 1 year.[4,5]

Anaesthetic drugs inhibit sensation, thereby decreasing pain during surgical procedures. These drugs attach to sodium channel receptors on the surface of the axon membrane, which disrupts the channel's ability to allow the passage of sodium ions, hindering nerve conduction surrounding the targetted area.[6] Based on their chemical structure, these drugs are classified into ester and amide types of anaesthetics.[7] Amide-type anaesthetics are commonly used in practice, such as lidocaine and bupivacaine, are metabolised by the liver, and have a longer duration of action.[8] The choice of anaesthetic agent and duration of action depend on the specific procedure being performed, the patient's medical history, and the preferences of the anaesthesiologist or surgeon. A, LA cartridge is composed of an LA agent and a vasoconstrictor, along with preservatives, antioxidants, and potential of hydrogen (pH) stabilisers, which help ensure the stability and efficacy of the anaesthetic solution.[4]

LAs are capable of producing anaesthesia in specific nerves and areas of the body. However, it is important to keep in mind that although rarely, these medications can still be toxic in high doses and produce both local and systemic

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complications. Therefore, it is essential to adhere to recommended dosages and carefully monitor patients during and after LA administration to minimise the risk.[9]

Practitioners may sometimes resort to untested techniques or overlook important aspects of drug administration, putting the patient's wellbeing at risk. Dental practitioners ought to be well-informed on dosage calculations, management of LA complications and the signs and symptoms of allergic and toxic side effects to minimise the risk of adverse situations.[10]

House officers (HOs) are recent dental school graduates completing their one-year internship as part of their training to gain practical experience under the supervision of experienced dentists in a clinical setting. They are an integral part of a healthcare setup, are specialists in the making, and are directly involved in LA administration in outpatient clinics. They play a crucial role in teaching facilities, as they directly interact with patients and are responsible for providing safe and effective care. As such, it is essential that they receive adequate training in clinical safety and dosage calculations, particularly in LA administration. Systemic toxicity can occur if plasma levels of anaesthetic rise above the recommended levels.[11,13]

To our knowledge, no study has been conducted in Pakistan to evaluate HOs' awareness regarding LA administration. The current study was planned to fill the gap by assessing the knowledge and awareness of dental HOs regarding calculation of LA dosage, and to evaluate differences in practices at various tertiary care facilities.

Subjects and Methods

The prospective, analytical, cross-sectional study was conducted from July to December 2022 at the three dental hospitals affiliated with the Dow University of Health Sciences (DUHS), Karachi; the Dow International Dental College (DIDC), the Dow Dental College (DDC), and the Dr Ishratul Ebad Khan Institute of Oral Health Sciences (DIKIOHS).

After approval from the DUHS ethics review committee, HOs of either gender currently enrolled at the participating centres were approached. Post-graduate trainees were excluded.

After taking informed consent from the subjects, data was collected anonymously using a self-administered questionnaire to assess the knowledge and awareness of HOs regarding the most used LA, its dosage calculation, commonly used methods of LA administration, and the most frequently encountered post-LA complication. The questionnaire was developed in the light of an earlier study.[14] Questions relating to the maximum dose were based on the recommendations given in Malamed's Handbook of Local Anaesthesia.[15] The questionnaire was checked by two dental consultants for content validity, and their suggestions were incorporated. The questionnaire had 4 sections; demographic data, knowledge about dosage calculation and safe, maximum LA dose, common LAs in practice and their mode of administration, and common complications encountered post-LA.

The HOs were approached during work hours. Those who volunteered, were handed the questionnaire and they were requested to fill it on the spot. This step was taken to avoid bias in results.

Data was analysed using SPSS 26. Data was presented as frequencies and percentages. Chi-square or Fischer exact test was used as appropriate. P<0.05 was considered significant.

Results

Of the 200 subjects approached, 136(68%) responded. Of them, 54 (39.7) were from DDIC, and 89(65.4%) were

Table-1: Respondents' data (n=136).

	Total n (%)	Male n (%)	Female n (%)
DIDC	54 (39.7)	20 (37.0)	34 (62.9)
DDC	37(27.2)	12 (32.4)	25 (67.6)
DIKIOHS	45(33.0)	15 (33.3)	30(66.7)

DIDC: Dow International Dental College, DDC: Dow Dental College, DIKIOHS: Dr Ishratul Ebad Khan Institute of Oral Health Sciences.

Table-2: Responses to questions related to LA dose.

	Total n (%)	DIDC n (%)	DDC n (%)	DIKIOHS n (%)
In a 2% Lidocaine solution what does the 2% indicate?				
2mg/ml	67 (49.2)	28 (51.8)	15 (40.5)	24 (53.3)
[a]*20mg/ml*	45 (33.0)	17(31.5)	12 (32.4)	16 (35.5)
00mg/ml	20(14.7)	9(16.6)	6 (16.2)	5 (11.1)
2000mg/ml	4(2.9)	0	4 (10.8)	0
p-value	0.82			
What is the maximum dosage of 2% Lidocaine with epinephrine?				
2.4mg/kg	31(22.8)	8 (14.8)	9 (24.3)	14(31.0)
4.4mg/kg	68 (50.0)	24 (44.4)	16 (43.2)	28(62.2)
6.4mg/kg	30 (22.0)	18 (33.3)	10 (27.0)	2 (4.4)
8.4mg/kg	7 (5.15)	4 (7.4)	2 (5.4)	1(2.2)
p-value	0.13			
What maximum number of 1.8ml cartridges of 2% Lidocaine with epinephrine can be given to 70kg adult healthy patient?				
6	10 (7.35)	4 (7.4)	5 (13.5)	1 (2.2)
8	67 (49.3)	33 (61.1)	15 (40.5)	19 (42.2)
12	52 (38.2)	16 (29.6)	12 (32.4)	24 (53.3)
14	7 (5.14)	1 (1.8)	5 (13.5)	1 (2.2)
p-value	0.08			

[a]The correct response has been mentioned in italics; LA: Local anaesthesia, DIDC: Dow International Dental College, DDC: Dow Dental College, DIKIOHS: Dr Ishratul Ebad Khan Institute of Oral Health Sciences.

females (Table-1). Knowledge regarding the meaning of 2% lidocaine solution was low 45(33%), and there was no significant difference in the responses of HOs from different institutions (p=0.82). Besides, 68(50%) subjects were knowledgeable about the maximum dosage of lidocaine with epinephrine. Responding to the inquiry about the maximum number of 1.8ml cartridges with epinephrine that can be given to a 70kg adult patient, 67(49%) HOs gave the correct response (Table-2). The difference among HOs from different institutions was not statistically significant (p=0.08).

Table-3: LA administration practices.

	DIDC n (%)	DDC n (%)	DIKIOHS n (%)
Commonly used LA in practice			
Lidocaine	41 (83.0)	29 (78.0)	45 (100.0)
Bupivacaine	8 (15.0)	7 (19.0)	0
Mepivacaine	4 (7)	0	0
Articaine	0	1 (3.0)	0
p-value	0.004*		
LA administration			
with vasoconstrictor	47 (87.0)	35 (95.0)	45 (100)
without vasoconstrictor	7 (13.0)	2 (5.0)	0
p-value	0.163*		
Performing aspiration while giving LA			
Yes	21 (39.0)	8 (22.0)	8 (18.0)
No	33 (61.0)	29 (78.0)	37 (82.0)
p-value	0.804*		
LA administration methods HOs can give without supervision			
Topical	48 (89.0)	37 (100)	45 (100)
Local infiltrate	48 (89.0)	37 (100)	45 (100)
Inferior alveolar block	47 (87.0)	37 (100)	45 (100)
Cowgates	9 (17.0)	0	0
Vesirani Achinos	5 (9.0)	1 (3.0)	0
Mental nerve block	22 (41.0)	4 (11.0)	0
Intraorbital foramen block	8 (15.0)	0	0
Anterior superior/Middle superior/ Posterior alveolar nerve block	14 (26.0)	1 (2.0)	0

LA: Local anaesthesia, DIDC: Dow International Dental College, DDC: Dow Dental College, DIKIOHS: Dr Ishratul Ebad Khan Institute of Oral Health Sciences, HO" House officer.

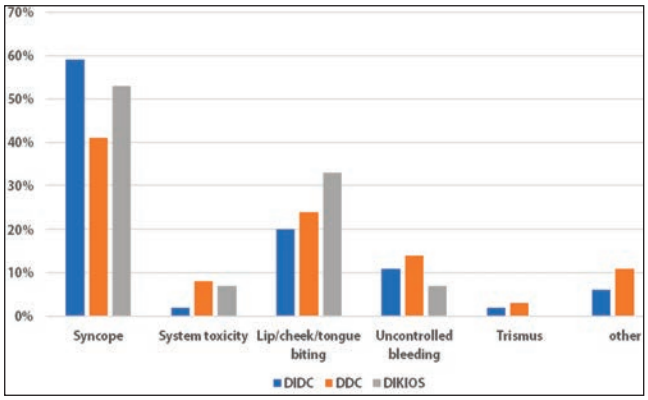

Figure: Reported side effects of LA administration.

LA: Local anaesthesia, DIDC: Dow International Dental College, DDC: Dow Dental College, DIKIOHS: Dr Ishratul Ebad Khan Institute of Oral Health Sciences.

In terms of practice, lidocaine was the most commonly administered local anaesthetic 115(85%), followed by bupivacaine 15(11%). The majority of subjects administered local anaesthesia with vasoconstrictor 127(94%), but only 36(27%) performed aspiration during administration (Table-3).

Syncope 71(52%) was the most commonly reported complication, followed by lip/cheek/tongue biting by 35(26%) (Figure).

Discussion

The current study found that only half of the HOs displayed better knowledge about LA dosage, which is concerning because inadvertent overdoses can have potentially lethal outcomes.[16] The results support recent findings related to paediatricians regarding LA dosage calculation.[17] In another recent study, dental practitioners did not display satisfactory levels of knowledge about LA dosage.[18]

Among the 136 respondents, 65% were females, which represented the overall trend of higher women-to-male ratio in DUHS dentistry stream. The highest number of responses was obtained from DIDC, likely due to its role as the primary base station for the study. This positioning allowed for convenient access to HOs who were readily available and more inclined towards cooperating.

Based on the findings, 50% of HOs were familiar with the maximum dosage of 2% lidocaine with epinephrine, and the highest number of LA cartridges that may be safely administered to a healthy adult. While this highlighted a concerning lack of knowledge among the remaining HOs, it emphasised the critical importance of implementing comprehensive training sessions on LA administration. These results, however, appeared more promising compared to a similar study conducted on general dental practitioners in Saudi Arabia.[14]

There was no significant difference in responses across the institutions surveyed. This may be due to similar teaching practices, shared faculty, and uniform curriculum. This alarming lack of knowledge emphasised the necessity of educational initiatives to raise HOs' awareness, and to provide relevant training regarding LA administration.

Lidocaine was the most frequently administered LA agent in the current study, as is reported in international literature.[19] Aspiration is recommended during the administration of local anaesthetic to minimise the risk of systemic toxicity, ensure accurate delivery of the anaesthetic, and prevent local complications.[20] However, only 27% of the current HOs said they used aspiration while

giving LA. This was especially worrying since high levels of toxicity could be achieved by the accidental intravascular injection of LA.

All the HOs from DDC and DIKIOHS claimed to be able to give inferior alveolar blocks, tropical anaesthesia, and local infiltrate without supervision, but this number was slightly lower for DIDC. However, a significant number of HOs from DIDC reported to know other LA administration techniques. These slight differences in results may be due to variety in training programmes and exposure of clinical practice among the institutions. Another factor may be the relative size of facilities and respective patient turnover. In this regard, DIKIOHS was the largest facility, dealing with the highest number of patients on a daily basis.

The complications encountered by DUHS dentists in their clinics were mainly syncope, followed by lip/cheek/tongue biting and uncontrolled bleeding. Most adverse events are controllable because they arise due to the patient being overly anxious or not well-informed. Thus, the LA technique must address several aspects, including patient counselling, distraction and careful dose administration.

The current study specifically chose HOs as subjects due to their vital role within healthcare institutions and their status as future specialists. In the past, there have been tragic instances where inadvertent intravascular injection of lidocaine during regional anaesthesia resulted in fatal consequences.[21,22] Additionally, a case series displayed the dire need to make well-informed decisions regarding LA administration by reporting symptoms of topical lidocaine toxicity, with a mortality rate of 10%.[23] To prevent such devastating events from occurring in the future, it is crucial to enhance HOs' awareness and understanding of LA administration. Furthermore, there is an urgent need for clinical practices to prioritise safety and supervision. To address this knowledge gap, it is advisable to introduce additional education and mandate standardised training programmes. By implementing these measures, patient safety can be ensured by minimising the occurrence of adverse events.

The current study has limitations. It was basically a single-centre study conducted at three constituent institutions, and, hence, little variety in responses was observed. Also, the small sample size and the low response rate limited the generalisability of the findings, which relied heavily on self-reported data. There were no standard measures that would have allowed verification or validation of the responses.

Conclusion

A significant knowledge gap was observed, with low awareness of the meaning of a 2% lidocaine solution and the maximum safe dosage of lidocaine with epinephrine. Also, there were misconceptions regarding common complications of LA. There was a need for targetted educational interventions to improve knowledge and practices among HOs regarding LA administration.

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WZ, AA: Concept, data collection, writing-original draft preparation.
MSQ: Data collection, writing-original draft preparation and visualization.
NW: Data collection and writing-original draft preparation.
ACS: Writing, review and editing, supervision.
TFA: Methodology, formal analysis, writing-original draft preparation, writing, review and editing, supervision.