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Neurological and autonomic manifestations in Anatomy dissection lab: A cross - sectional study from Nepal

Roy B[1], Banerjee I[2], Sathian B[3], Pugazhandhi B[4] , Khan I A[5], Upadhya R[6]

[1]*Assistant Professor, Department of Physiology, Manipal College of Medical Sciences, Pokhara, Nepal.*
[2]*Lecturer, Department of Pharmacology, Manipal College of Medical Sciences, Pokhara, Nepal.*
[3]*Assistant Professor, Department of Community Medicine, Manipal College of Medical Sciences, Pokhara, Nepal.*
[4]*Lecturer, Department of Anatomy, Manipal College of Medical Sciences, Pokhara, Nepal.*
[5]*Professor, Department of Physiology, Manipal College of Medical Sciences, Pokhara, Nepal.*
[6]*Former Professor and Head, Department of Anatomy, Manipal College of Medical Sciences, Pokhara, Nepal.*

Edited by:
Dr. A.K.Pradhan, KIMS, Amalapurum, India
Vice President CMRA

Reviewed by:
Dr.P.Kumar, California, United States

Dr.N.Mishra, LMC, Nepal

****Correspondence:***
Bedanta Roy
Assistant Professor,
Department of Physiology,
Manipal College of Medical Sciences,
Pokhara, Nepal.

Email:
bedanta.roy@gmail.com

Full list of author information is available at the end of the article

Background:
Anatomy is a fundamental and important most part of the medical curriculum; which gives the sound understanding of human anatomy for the future training in the clinical subjects like surgery. Formalin is used as preservative substance for cadavers. The main objective of the research was to find out the common neurological and the autonomic manifestations associated with dissection.

Methods:
A questionnaire based study was carried out in the Basic Science Campus of Manipal College of Medical Sciences, Pokhara, Nepal. The questionnaire included Ophthalmological, ENT and other clinical manifestations associated with dissection.

Results:
Indian students comparatively more nauseous. Among the Nepalese students discomfort and headache were more followed by Indians and Srilankan students. Males had [OR 2.53 (1.198, 5.343)] times more shivering hand than females during dissection. They also experienced dryness of mouth, sweating and pass out [OR 2.158 (1.377, 3.381)], [OR 2.250 (1.490, 3.396)] and [OR 5.539 (2.420, 12.676)] times respectively compared to females.

Conclusion:
In this study we found that, comparing with other researches, dissection associated clinical manifestations was relatively less in MCOMS. This is practically impossible to remove preservative substances from the dissection lab entirely, but adopting suitable measures can reduce risks to the health of the medical students. Improvement in ventilation by using more exhaust fans in windows, installation of dissection tables equipped with local exhaust ventilation system is more effective in this context. Giving short breaks in dissection sessions, protective measures like, activated carbon mask, goggle and rubber glove for sensitive students can improve the scenario in future.

Keywords: Anatomy, Cadaver, Clinical manifestation, Dissection, Formalin, Medical student, Nepal.

Background

Anatomy is the study about the structure and learning of the three-dimensional aspect of the human body, it is one of the most basic, important subjects studied by medical students in the beginning of their medical career [1]. This is a crucial part of the medical curriculum; which gives sound understanding of human body organs for future training in clinical subjects like surgery. The study of anatomy is also helpful for further development of medical professionalism [2]. Dissection is the practical aspect of anatomy which imparts subject knowledge and other important positive learning opportunities. This significantly influences the skills and attitudes of future medical professionals [3]. Cadavers have been used universally and traditionally as the primary pillar for the practical aspect of anatomy [4]. During cadaver dissection, students can learn the anatomy directly from the cadavers which help them to conceptualize the subject permanently [5]. The first exposure to a cadaver may cause emotional shock and mixed feelings to the first year medical students, though repeated exposure makes them comfortable to adopt a professional attitude and accept it mentally as an integral part of the teaching/learning process [6].

Apart from the emotional aspect of dissection, medical students encounter with fumes of a chemical substance, "Formalin", in the dissection rooms [7] which indicates certain clinical manifestations leading to airway irritation and obstructive disorders such as asthma, ocular irritations, carcinomas (namely leukemia and nasopharyngeal carcinomas) ,female reproductive disorders, dermatitis, skin sensitization [8-11]. A concentration of formaldehyde higher than 0.5mg/m2 can induce dose related signs and symptoms like dryness in the nose, throat and conjunctiva. A number of studies carried out in different parts of the globe have shown the numerous health challenges medical students and professionals exposed to formaldehyde face [12-18].

The main objective of the research was to find out the common neurological and autonomic manifestations associated with dissection amongst medical students studying in Nepal with 40% formalin-treated cadavers. This is the first study reported from Nepal.

Material and Methods

Study Period

The present study was undertaken during the period of 15thMarch 2012 to 15th July 2013.

Study design and the participants

This prospective questionnaire based study was carried out at the Manipal College of Medical Sciences, Pokhara in Nepal. Printed copies of questionnaires, based on the factors associated with clinical manifestations during dissection were distributed among students. They were completed voluntarily and anonymously.

Response Rate

Out of 415 students, 406 filled the questionnaires duly which indicated an overall response rate of 97.83%.

Questionnaire design and Validity

A Dichotomous questionnaire was designed to obtain clinical manifestations of CNS and autonomic manifestations with dissection. For each question, students were given the option to choose "yes" or "no".

The questionnaire was instigated with specific instructions followed by demographic data. Students were instructed not to enter any identifiable personal details like name, address, or roll number. To protect confidentiality, unique study identification numbers were used. For content validity, pilot study was done among 10 volunteer medical students, 3 senior residents and 4 faculty members among them two were subject experts (Dr. Rajandra Upadhya – Professor, Department of Anatomy and Mr. Pugazhandhi – lecturer department of Anatomy); who commented on the relevance and unambiguity of the questionnaire. After discussion of results and feedback, a final questionnaire was made. Validation tests showed that the Alpha Cronbach was 0.69.

Data collection

Investigators of the study collected data personally by distributing the questionnaires amongst the first year students of Basic Sciences from 15th March 2012 to 15th July 2013. They were asked to answer each question frankly, honestly and after understanding it properly.

Inclusion criteria

All the first year students of Basic Sciences were included in the study from Manipal College of Medical Sciences, Pokhara, Nepal (MCOMS). MCOMS is the oldest private medical of Nepal which was established in 1994.

Exclusion criteria

Students who were not willing to participate voluntarily or who filled the questionnaire incorrectly or incompletely were excluded so as to avoid study bias.

Sample size calculation

From the pilot study of 10 students, 90% showed clinical manifestations during dissection so P=90% Q=100 - 90=10%, E=4% of P = 3.6 and sample size required was 267[19].

Outcome variables

Clinical signs and symptoms associated with CNS some autonomic effects were considered as outcome variables.

Explanatory variables

The demographic factors defined at individual level including age, gender and nationality; were set as explanatory variables.

Ethical committee approval

This research study was conducted in accordance with the latest version of the Declaration of Helsinki. Approval was taken from the Research Ethical Committee of Manipal College of Medical Sciences.

Data management and statistical analysis

Descriptive statistics and testing of hypothesis were used for the analysis. The collected data were analyzed using Statistical Package for the Social Sciences (SPSS) for Windows Version 16.0 (SPSS Inc; Chicago, IL, USA). The associations between the different variables were tested using the Chi-square test and strength of the relationship with logistic regression. We calculated odds ratios (OR) and their 95% confidence intervals (95% CI). A p value less than 0.05 was considered statistically significant

Results

Among 406 medical students from three different nationalities, Indian students comparatively more nauseous. None of the Srilankan students complained about dizziness which was significant. Weakness was comparatively less among Indians. Among the Nepalese students discomfort and headache were more followed by Indians and Srilankan students. Among the males who complained shivering hand during dissection was almost double compared with females. Smell sensation also hampered males more than females for a long time [**Table 1**].

None of the Sri Lankan students reported shortness of breath which was significant. Dryness in mouth was more common in Nepalese, followed by Indian and Sri Lankan students. Sweating during dissection was reported by almost half of the Nepalese students, followed by Indian and Sri Lankan students. All though complains of pass out were significantly less the number of complaints from Nepalese students was double that of Indian students. Males complained more about dry mouth, sweating and pass out which were statistically significant [**Table 2**].

Table – 2: Autonomic effects [n(%)]

Nationality	Feeling faint		Short of breath		Dry mouth		Sweaty		Pass out	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Nepali	206 (92.8)	16 (7.2)	197 (88.7)	25 (11.3)	140 (63.1)	82 (36.9)	117 (52.7)	105 (47.3)	186 (83.8)	36 (16.2)
Indian	123 (93.9)	8 (6.1)	115 (87.8)	16 (12.2)	96 (73.3)	35 (26.7)	87 (66.4)	44 (33.6)	119 (90.8)	12 (9.2)
Sriankan	53 (100)	0 (0.0)	53 (100)	0 (0.0)	50 (94.3)	3 (5.7)	38 (71.7)	15 (28.3)	53 (100)	0 (0.0)
P value	0.135×		0.031†		0.000†		0.006†		0.002†	
Female	168 (92.8)	13 (7.2)	162 (89.5)	19 (10.5)	143 (79.0)	38 (21.0)	127 (70.2)	54 (29.8)	174 (96.1)	7 (3.9)
male	214 (95.1)	11 (4.9)	203 (90.2)	22 (9.8)	143 (63.6)	82 (36.4)	115 (51.1)	110 (48.9)	184 (81.8)	41 (18.2)
P value	0.330×		0.811×		0.001†		0.000†		0.000†	

†p<0.05, statistically significant
×p>0.05, statistically not significant

Table – 1: CNS manifestations [n(%)]

Nationality	Nauseous		Dizziness		Weakness		Discomfort		Restlessness		Headache		Disturbed sleep		Shivering hand during dissection		Cant Smell Long	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Nepali	186 (83.8)	36 (16.2)	182 (82.0)	40 (18.0)	192 (86.5)	30 (13.5)	113 (50.9)	109 (49.1)	161 (72.5)	61 (27.5)	154 (69.4)	68 (30.6)	219 (98.6)	3 (1.4)	205 (92.3)	17 (7.7)	176 (79.3)	46 (20.7)
Indian	103 (78.6)	28 (21.4)	111 (84.7)	20 (15.3)	125 (95.4)	6 (4.6)	90 (68.7)	41 (31.3)	93 (71.0)	38 (29.0)	97 (74.0)	34 (26.0)	122 (93.1)	9 (6.9)	115 (87.8)	16 (12.2)	94 (71.8)	37 (28.2)
Sriankan	43 (81.1)	10 (18.9)	53 (100)	0 (0.0)	46 (86.8)	7 (13.2)	43 (81.1)	10 (18.9)	38 (71.7)	15 (28.3)	47 (88.7)	6 (11.3)	50 (94.3)	3 (5.7)	47 (88.7)	6 (11.3)	46 (86.8)	7 (13.2)
P value	0.0475†		0.004†		0.025†		0.000†		0.953×		0.016†		0.021†		0.337×		0.063×	
female	152 (84.0)	29 (16.0)	155 (85.6)	26 (14.4)	158 (87.3)	23 (12.7)	113 (62.4)	68 (37.6)	136 (75.1)	45 (24.9)	126 (69.6)	55 (30.4)	175 (96.7)	6 (3.3)	171 (94.5)	10 (5.5)	151 (83.4)	30 (16.6)
male	180 (80.0)	45 (20.0)	191 (84.9)	34 (15.1)	205 (91.1)	20 (8.9)	133 (59.1)	92 (40.9)	156 (69.3)	69 (30.7)	172 (76.4)	53 (23.6)	216 (96.0)	9 (4.0)	196 (87.1)	29 (12.9)	165 (73.3)	60 (26.7)
P value	0.302×		0.833×		0.214×		0.496×		0.196×		0.122×		0.716×		0.012†		0.015†	

†p<0.05, statistically significant
×p>0.05, statistically not significant

Considering the CNS manifestations, majority of the students felt discomfort - 39.4%, followed by restlessness, headache, and absence of smell sensation for long time and nausea. Among them Sweating 40.4% and dryness in mouth 29.6% were the commonest features of Autonomic complications; followed by pass out and shortness of breath, 11.8% and 10.1 % respectively [**Table 3**].

Table – 3: Overall CNS and Autonomic Manifestations

CNS manifestations [n(%)]							
Nauseous	**Dizziness**	**Weakness**	**Discomfort**	**Restlessness**	**Headache**	**Shivering hand during dissection**	**Cant Smell Long**
74 (18.2)	60 (14.8)	43 (10.6)	160 (39.4)	114 (28.1)	108 (26.6)	39 9.6)	90 (22.2)
Autonomic effects [n(%)]							
Feeling faint	**Short of breath**	**Dry mouth**	**Sweaty**	**Pass out**			
24 (5.9)	41 (10.1)	120 (29.6)	164 (40.4)	48 (11.8)			

Determinants of clinical manifestations and Gender of the students by logistic regression

Males had [OR 2.53 (1.198, 5.343)] times more shivering hand than females during dissection. Male student were also experienced dryness of mouth, sweating and pass out [OR 2.158 (1.377, 3.381)], [OR 2.250 (1.490, 3.396)] and [OR 5.539 (2.420, 12.676)] times respectively compared to females [**Table 4**].

Discussion

Over the last 10–15 years, more attention has been drawn to the traumatic effects of dissection among students and suggestions regarding such trauma and subsequent education and practice are more [20]. The very peculiar smell of formalin is the hallmark of dissection hall. During gross anatomy cadaver dissection, formaldehyde vapor exposure and skin contact with formalin solution can cause several adverse effects. This vapor can irritate the respiratory tract, eyes and cause lacrimation, burning of the nose and throat, dyspnea, and headache[21]. Research work also supports that some individuals are relatively more susceptible to the adverse effects, but others have no reaction to the exposure at the same levels [22].

CNS manifestations associated with Dissection

Some Indian studies were similar to our research where 22% and 30% of the total students complained about nausea [23, 24]. A study done by Arora L shows that the feeling of Nausea was comparatively more in males than females which supports our work [25]. Research work done by Patel B showed that 12% of Indian students complained about dizziness, which was almost similar to our findings. Studies conducted in different parts of the globe also support this [26, 27]. Relatively less Indian students felt weakness in our study, which was dissimilar with other works where complaints were more. 21% of the total population reported weakness [24]. In this context, females suffered more which may be associated with the fear factor [28].

Studies in Tehran and Nigeria showed that there was general fatigue and discomfort in one third and 81% of students respectively [27]. Although majority of Nepalese students complained about fatigue this was comparatively less amongst Indians and Sri Lankans [29]. Restlessness was common which prevailed among all three nationalities. The leading cause behind this may be anxiety and stress immediately before and during dissection. Different research carried out in India correlates with our findings where 18.75% experienced considerable anxiety and stress immediately before and during dissection [30]. In another study, 8% reported shivering hands which were similar to our results [31]. Smell sensation was also hampered due to side effect of formalin vapor. A Study by Arora et al showed, 35.28% of the students had experienced this problem, which also supported our findings [25].

Table - 4: Logistic Regression Table of various clinical manifestations and Gender of the students

CNS manifestations - Odds Ratio (Confidence Interval)								
Gender	**Nauseous**	**Dizziness**	**Weakness**	**Discomfort**	**Restlessness**	**Headache**	**Shivering hand during dissection**	**Can't Smell Long**
Male	1.310(0.784, 2.191)×	1.061(0.611, 1.845)×	0.670(0.355, 1.264)×	1.149(0.769, 1.717)×	1.337(0.861, 2.076)×	0.706(0.454, 1.098)×	2.53(1.198, 5.343)†	1.830(1.120, 2.990)†
Female	1	1	1	1	1	1	1	1
	Autonomic effects - Odds Ratio (Confidence Interval)							
	Feeling faint	Short of breath	Dry mouth	Sweating	Pass out			
Male	0.664(0.290, 1.520)×	0.924(0.484, 1.766)×	2.158(1.377, 3.381)†	2.250(1.490, 3.396)†	5.539(2.420, 12.676)†			
Female	1	1	1	1	1			

† $p<0.05$, statistically significant,

× $p>0.05$, statistically not significant.

Patel B et al reported offensive smell was a fear factor for 42.67% students [23]. Some study outcomes were very interesting, where 66.66% of the students responded positively about formalin smell even though they were away from college [24] which may be due to olfactory adaptation. Arora et al reported females are less prone to this smell related problem which resembles our result [25].

Autonomic effects after exposure with cadavers

Relatively fewer students complained about feeling faint, because other students became psychologically strong after repeated cadaveric exposure. Moderately less Indian and Sri Lankan students suffered shortness of breath, though some other studies had shown, more than one third of students complained about this problem. This was also observed in other studies [32]. This may be due to anxiety and stress immediately before and during dissection. This finding is similar to the finding of research done in India where 18.75% experienced considerable anxiety and stress immediately before and during dissection [30]. Interestingly none of the Sri Lankan students reported such effects. Amongst the Nepalese, it had been noticed that sweating was more common, which may be due to more stress and anxiety during dissection. We noticed that Nepali students also felt more urge to urinate compared with Indian students. None of the Sri Lankans complained about pass out. All this autonomic reactivity's may be associated with anxiety level due to cadaveric exposure. Males suffered more compared with females in dryness in mouth, sweating and pass out.

Common physiological and clinical manifestations during dissection

Dissimilar research studies available showing the different physical symptoms during Anatomy dissections, support our study [21, 22]. Research works in Tehran and Nigeria show that there was general fatigue and discomfort amongst medical students, which support our findings [27]. Restlessness and smell related problems were also a disadvantageous aspect of dissection, a finding which was repeatedly found [30, 24]. Autonomic manifestations were also a part of dissection due to anxiety and stress which supports other works [30, 32].

Conclusion

In this study we found that, comparing with other researches, dissection associated clinical manifestations was relatively less in MCOMS. Among the CNS manifestations, majority of the students felt discomfort followed by restlessness, headache, absence of smell sensation for long time and nauseous feeling. This may be due to the usage of hazardous preservative substances in the dissection lab. It is practically impossible to remove hazardous preservative substances from the dissection lab entirely, but adopting suitable measures can reduce risks to the health of the medical students.

It is recommended that there should be improvement in ventilation by using additional exhaust fans in windows, installation of dissection tables equipped with local exhaust ventilation systems would be more effective in this context. Negative - pressure ventilation and monitoring systems should be installed to reduce formaldehyde vapor air concentration. Students should not be allowed inside the dissection hall for periods no longer than an hour at a time, and taking short breaks between dissections sessions could be beneficial.

A pragmatic approach to formalin Safety could be done by allowing sensitive students to take protective measures such as wearing an activated carbon mask and rubber gloves during dissection. Introduction of alternative chemicals like glutaraldehyde, which are safer and nontoxic, may be considered in place of formaldehyde as an embalming fluid.

Limitations & future scope of the study

The main drawback of the present study was that area concentrations of formaldehyde were not measured. Multicentric institutional based similar studies should be carried out in anatomical departments of other medical colleges of Nepal with formalin levels.

Competing interests

The authors declare that they have no competing interests.

Abbreviations

CNS – Central Nervous System.

Authors' contribution

BR, IB and PB designed the questionnaire, interpreted the data, drafted the manuscript, and revised it. BR conceived of the study with IB, RU, PB and SK acquired & interpreted the data and revised the manuscript. BS took part in data analysis, interpreted the data, and revised the manuscript. RU critically revised the manuscript. BR and IB edited the English language of the manuscript.

Authors' information

Bedanta Roy Currently working as Assistant Professor in the Department of Physiology, Manipal College of Medical Sciences, and Pokhara, Nepal. His PhD work is □□ Neurophysiology. He is in the editorial board of Nepal Journal of Epidemiology (NJE). He was an Organizing Committee member of International Epidemiological Association Conference 2013 and Confederation of Epidemiological Associations (CEA) Conference December 2013.

Dr. Indrajit Banerjee MBBS, MD Pharmacology. Currently working as a Lecturer in the Department of Pharmacology,

Manipal College of Medical Sciences, Pokhara, Nepal and Chief of Manipal Sanjeevani Clinic. He is in the editorial board of Medical Science (MS), and Nepal Journal of Epidemiology (NJE). He was an Organizing Committee member of International Epidemiological Association Conference 2013 and Confederation of Epidemiological Associations (CEA) Conference December 2013 Organized by Mahatma Gandhi University.

Dr. Brijesh Sathian MD(AM), PhD. working as Assistant Professor and Bio-statistics Chief in the Department of Community Medicine, Manipal College of Medical Sciences, Pokhara, Nepal. He is the editorial board member of NJE, IJBS, AIIJMS, GMJ and Joint Organizing Secretary and treasurer of International Epidemiological Association Conference 2013.Joint Organizing Secretary CEA (Confederation of Epidemiological Associations) Conference December 2013 Organized by Mahatma Gandhi University.

Mr. Pugazhandhi B, currently working as a Lecturer in the Department of Anatomy, Manipal College of Medical Sciences, Pokhara, Nepal. He is the editorial board member of MS.

Dr. Iftikhar Ali Khan, currently working as a Professor in the Department of Physiology, Manipal College of Medical Sciences, Pokhara, Nepal.

Dr. Rajendra Upadhya worked as a Professor and Head in the Department of Anatomy, Manipal College of Medical Sciences, Pokhara, Nepal.

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