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PERCEPTION AND RISK OF EXPOSURE TO XYLENE BY PATHOLOGIC ANATOMY STUDENTS

Abstract: This study intends to assess the perceived and real risk of occupational exposure to xylene by students in bachelor degree of pathologic anatomy, cytology and thanatology. A questionnaire was produced and validated (Likert scale) applied to a sample of 217 students in higher education. Air samples were collected using activated charcoal cartridges. The quantification of the three xylene isomers (ortho, meta, and para) was performed by GC-FID.

With respect to perception and the classification of the risk of exposure to xylene for 35.9% of individuals corresponds to moderate risk (MR), 30.8% of high risk (HR), 28.2% of low risk (LR) and 5.1% of no risk (NR). The handling of this compound without gloves for 59.9% of students in MR, 21.5% for VR, 16.3% for LR and 2.3% of NR. For 56.7% of students there is danger of exposure to xylene. Xylene concentrations in laboratories environment were found at the range of 113.15-714.93 ppm and vary along of the week. The average concentration of total xylenes was 169.38 ± 76.15 ppm, which is below the Threshold Limit Values – Time Weighted Average (TLV-TWA). The highest occupational exposure occurred at slide mounting stage of the histological processing.

Introduction

Laboratory is inherently potentially dangerous environments and there will be always a level of risk associated with the work undertaken. In laboratories (where a variety of hazards exist) the workers must be closely supervised at all times. People who work in histology laboratory and related disciplines are at risk from exposure to risk agents. This risks can be traumatic for individuals, as well as extremely toxic (Buesa, 2007; Vecchio, Sasco and Cann, 2003).

The chemical hazards depending on the specific compound has the potential to poison (toxics, including carcinogens, teratogens and mutagens), burn (corrosive), irritate, produce allergic reactions, explode, ignite or asphyxiate. They can affect us by inhalation, skin contact and ingestion. So may pose immediate consequences for the health or long-term (Buesa, 2007). The presence of technicians of pathologic anatomy, cytologic and thanatologic, it is essential to ensure a smooth functioning of a laboratory of pathology and cytological (Ferrand and Bernard, 1995). Inexperienced workers are persons at special

risk (including undergraduate students and school pupils on “work experience” schemes), deserves special attention. The adequate processing of tissues and body fluids require the use of chemical substances. A hazardous chemical by the Occupational Safety and Health Administration (OSHA), is a substance that may cause health effects in short- or long-term exposed employees, based on statistically significant evidence from at least one study conducted using established scientific principles (OSHA, 1994). It is certainly a broad definition that applies to all, or almost all of the chemicals typically used in laboratories. During academic training, the students need to handle chemicals, which can be classified according to Portuguese legislation, Portaria n.º 732-A/96 as extremely flammable, highly flammable, flammable, highly toxic, toxic, harmful, corrosive, sensitizing, irritant, toxic for reproduction, dangerous to the environment, explosive, incendiary, mutagenic and carcinogenic, putting in danger the man and the environment (Ministério da Economia, Ministério da Saúde and Ministério do Ambiente, 1996).

In pathology and histology laboratories, the chemicals more used are xylene, formaldehyde, the acids and ethanol, among other toxic substances that easily contaminate the air (Roy D. R., 1999), as well generate hazardous waste (xylene) (Environmental Protection Agency, 2000). The xylene is an important component of the routine, almost indispensable in laboratory and is often perceived by the technicians as a source of problems for the health (Agency for Toxic Substances and Disease Registry, 1999, 2005). The theme of the risk, as part of job security is recent and is not studied completely. The perception of risk interferes in behavior and with the preventive measures against the procedures that can cause injury and / or accidents (Sanders and McCormick, 1993). The main purpose of the psychological approach to Shrader-Frechette, focuses on responding to questions on the perception and acceptability of risks, after considering the views expressed by individuals, to which you are requested assessments of certain activities and / or dangerous technologies (Shrader-Frechette, 1985).

This study intends to assess the perceived and real risk of occupational exposure to xylene by students in bachelor degree of pathologic anatomy, cytologic and thanatologic.

Materials and Methods

Questionnaire

A descriptive survey was conducted during the period November of 2007 to May 2008 and information was collected on a sample of 217 students who attended randomly selected superior institute schools in Gandra (Portugal).

The questionnaire was extensive, but only a small portion of all the items will be used.

The question asked for a rating of global attitude to exposure occupational to xylene in Pathological Anatomy Laboratory, on a four-step category based in Likert scale. The categories on this group varied from “no risk” to “must risk”. In questionnaire socio-demographic data (gender, age, and academic level) were collected, and consisted in sources of danger: classification of risk of exposure to xylene; classification of risk of manipulation of xylene without gloves;

Study Population

All students in the sample received an anonymous self-administered questionnaire and a letter explaining the purpose of the study, advising that they were under no obligation to complete the questionnaire, explaining that the information obtained would remain confidential, that the research team was available to provide further clarification of questions when necessary.

The students were divided into four academic groups:

- First Degree: no classes in histology laboratory
- Second Degree: 2 hours per week in histology laboratory
- Third Degree: 21 hours per week in histology laboratory
- Fourth Degree: 2 hours per week in histology laboratory

Statistical analysis

The internal consistency reliability coefficients using Cronbach's alpha or scale reliability coefficient from SPSS 16.0.1 for Windows software (SPSS Inc, Chicago, Illinois, USA) were examined. The intraclass correlation coefficient was evaluated by Pearson's test and Mann-Whitney test. For all statistical tests a p-value below 0.05 was considered significant.

Air of Pathological Anatomy Laboratory Sampling

Air sampling was performed for the 3rd October of 2008 to 15th of January of 2009. Air samples (129) were collected using activated charcoal cartridges, between 9:00 am and 5:00 pm, during the 21 hours a week of academic training, all days except Tuesday and week-end.

Personal air values were measured by means of passive air samplers (SKC solid adsorbent badges, inc. catalog number 530-11) equipped with of charcoal (cartridge (SKC coconut shell charcoal adsorbent sample tubes, inc. catalog number 226-01)). As reported in the SKC certificate of quality, these cartridges are calibrated at 25°C. Confounding factors of temperature and humidity in determination of chemicals were not relevant. The passive-spread samplers were positioned in proximity to the respiratory airways at the collar of each subject during the daily work day (between 9:00 am and 5:00 pm). The sampling times were of around 15 min. The samples were analyzed using a GC Chrompack CP-9000 Series equipped with a flame ionization detector (FID) and capillary column VF-5ms, 30m x 0.225 mm ID, film 0.25µm.

Results

Validation

The used questionnaire was first tested in a pilot scale for testing feedback by format to enhance clarity, reliability of responses and validation. No modifications were necessary to the final questionnaire.

Demographics

Two hundred and fourteen undergraduated students of pathologic anatomy, citologic and thanatologic (1st, 2nd, 3rd and 4th) respondents were enrolled. There were 32 (14.7%) men and 185 (85.3%) women, the students characteristics are presented in Table I.

The test Komolgorov-Smirnov (KS) revealed that all variables do not have a normal distribution (the value of D ranges between 0.156 and 0.452; Lilliefors $\alpha = 5\%$).

Risk perception

In classifying the risk of exposure to xylene in the laboratory of histology, 35.9% of the sample survey classifies it as being of moderate risk, 30.8% of very risk; little risk of 28.2% and 5.1% of no risk. Although, the test Mann, revealed that there are no significant differences between the 1st year and 3rd year ($p = 0.084$; $\alpha = 0.05$), and the 2nd and 4th grade ($p = 0.239$; $\alpha = 0.05$). However there are significant differences between students of 1st year and 2nd year ($p = 0.003$; $\alpha = 0.05$); 1st year and 3rd year ($p = 0.049$; $\alpha = 0.05$) 1st year and 4th year ($p = 0.002$; $\alpha = 0.05$); 2nd year and 3rd year ($p = 0.000$; $\alpha = 0.05$); 3rd year and 4th year ($p = 0.000$; $\alpha = 0.05$); (Table II).

The use of Personal Protective Equipment (PPE) is in itself an increase of demands for workers, often causing discomfort and other undesirable effects, especially when used for long periods of time. When handling chemicals, it is recommended that gloves with the right kind of material be used to protect the worker from accidental spills or contamination. The use of PPE's contributed to reducing the exposure of all or part of the risks, as the reduction of accidents at work. The classification of the risk of xylene manipulation without gloves: for 59.9% of students is much risk, 21.5% moderate risk, 16.3% of low risk and 2.3%. The Mann-Whitney test showed that there are no significant differences between the 1st and 4th grade ($p = 0.055$; $\alpha = 0.05$). Although there are significant differences between students of 1st year and 2nd year ($p = 0.000$; $\alpha = 0.05$); 1st year and 3rd year ($p = 0.006$; $\alpha = 0.05$); 1st year and 4th year ($p = 0.000$; $\alpha = 0.05$); 2nd year and 3rd year ($p = 0.000$; $\alpha = 0.05$); 2nd year and 4th year ($p = 0.001$; $\alpha = 0.05$); 3rd year and 4th year ($p = 0.000$; $\alpha = 0.05$) (Table III).

The personal monitor air measurements were compared to the values of atmospheric air at the three histological stages (histological staining, slide mounting and chemical waste disposal. Figure I shows the results obtained for the ambient air contaminants. Each area represents the mean of 129 measurements of total xylenes. The mean of each gas was determined separately, and subsequently, these values were summed to arrive at data shown in Figure I.

The concentrations obtained for the three xylene isomers was show to vary along of the week. Xylene concentrations were found at the range of 113.15-714.93 ppm. The average concentration of total xylenes was 169.38 ± 76.15 ppm (mean \pm SD), which is below the Threshold Limit Values – Time Weighted Average (TLV-TWA). Significantly higher levels of xylene, were found during at histological staining and slide mounting. The highest occupational exposure occurred at slide mounting stage of the histological processing.

Discussion

The questionnaire showed an excellent Cronbach's alpha or scale reliability coefficient of 0.943 (lower bound of 95% CI of 0.935) indicating good internal consistency of the test instrument. This was probably due to a large number of items in the questionnaire.

Risks tend to be perceived differently for one's own person compared with others (Sjöberg L. and Engelberg E., 2009). The degree of risk attributed to increases in the light of an increasing frequency academic year, except for students enrolled in 3rd grade. The majorities of students in 1st grade has no opinion or attach little risk, the 2nd grade low or moderate risk, the 3rd grade considered little risk or no risk and the degree of risk assigned by the students and 4th grade ranges from low risk to much risk. Authors in another studies search similar tendencies for personal and general risks and risk taking for oneself and others (Stone E. R., Yates A. J. and Caruthers A. S., 2002).

Regarding the perception of risk to xylene is largely aware of the risk to which they are subject however the perception of students is higher in the 2nd and 4th grade. Regardless of exposure time there is always risk.

A higher level of Pathological Anatomy Laboratory air contamination was found in the slide mounting area with greater concentrations of xylenes. The values founded were higher than 100 ppm (established in standard NP 1796:2007).

Conclusion

The results demonstrate that the manipulation of organic solvents, which includes xylenes, requires, correct and adequate information, to the students and lab workers in general, about the chemical and health risks, since, roughly 25% of students had no opinion on the risk of exposure to xylene, which may indicate lack in the consciousness of the danger. Students should have more information about dangerousness of those chemical substances. The individual perception of risk is a critical component of the behavior of students.

Implementation of measures to improve indoor air quality in order to reduce occupational exposure, as there are environmental concentrations exceeds the TLV-TWA, mainly in the stages of staining and slides mounting.

Concentrations above 100 ppm may endanger the student's health, mainly assigned to develop their curricular activity for 21 hour in this laboratory, i.e. 24% of the population; Strategies for prevention which includes environmental monitoring and biomonitoring should be periodically.

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Characteristic	N	%	Mean ±SD
Gender			
Male	32	14.7	
Female	185	85.3	
Academic Level			
1st	62	29%	
2nd	49	23%	
3rd	49	23%	
4th	54	25%	
Age			22 ± 2

Table I – Selected Characteristics of the Study Population

	no risk (%)	little risk (%)	moderate risk (%)	much risk (%)
1st Year	14.3	21.4	57.1	7.1
2nd Year	0	7.7	56.4	35.9
3rd Year	10.2	69.4	4.1	16.3
4th Year	1.9	7.4	44.4	46.3
Total	5.1	28.2	35.9	30.8

Table II – Classification of Risk of Exposure to Xylene

	no risk (%)	little risk (%)	moderate risk (%)	much risk (%)
1st Year	3.3	10.0	40.0	46.7
2nd Year	0	0	7.0	93.0
3rd Year	2.1	51.1	14.9	31.9
4th Year	3.8	1.9	28.8	65.4
Total	2.3	16.3	21.5	59.9

Table III – Classification of Risk of Manipulation of Xylene Without Gloves

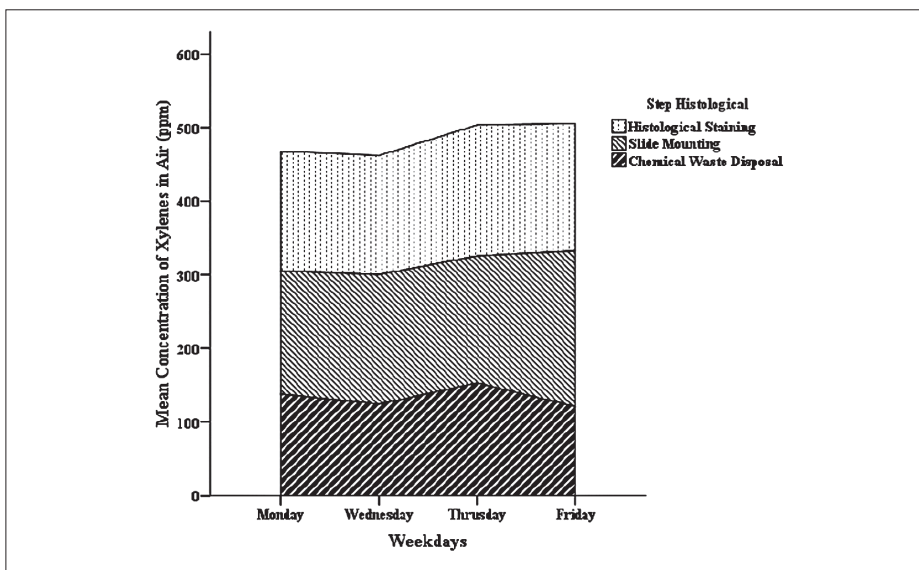


Figure I – Indoor Levels of Xylenes by Weekdays and Histological stage