ARCHIVES OF HELLENIC MEDICINE: ISSN 11-05-3992

ORIGINAL PAPER
ΕΡΕΥΝΗΤΙΚΗ ΕΡΓΑΣΙΑ

Percutaneous exposures among health care workers in a Greek tertiary hospital

ARCHIVES OF HELLENIC MEDICINE 2014, 31(6):718–724
ΑΡΧΕΙΑ ΕΛΛΗΝΙΚΗΣ ΙΑΤΡΙΚΗΣ 2014, 31(6):718–724

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OBJECTIVE **Percutaneous exposures (PCE) constitute a major occupational health problem for health care workers (HCW). Data on the incidence rate of PCE from Greek hospitals are sparse. The epidemiology of PCE was investigated in a tertiary care general hospital in Greece and compared with data from other countries.** METHOD **A cohort study was conducted, with prospective collection of data on all PCEs reported in two years in a 950-bed tertiary care general hospital. A standardized data collection form was used in face to face interviews with the HCW who reported each incident.** RESULTS **A total of 374 PCEs were recorded, giving an incidence rate of 23.1 per 100 occupied beds per year. The highest rate was recorded among nursing students, 25.5 per 100 full time equivalents (FTEs) per year. The incidence rate of PCE was significantly higher in medical than in surgical wards. The most common circumstances associated with a PCE were inappropriate sharps disposal (18.7%) and recapping (17.9%). In 29% of the PCEs the exposed HCW was injured by a needle inappropriately handled or disposed of by another person.** CONCLUSIONS **The incidence of PCEs in the study hospital is high in comparison to reports from other Greek hospitals and international documentation. Obvious causative factors are lack of education in safety issues, limited use of safety or needleless devices, high workload and understaffing.**

Διαδερμικές εκθέσεις υγειονομικού προσωπικού σε ελληνικό τριτοβάθμιο νοσοκομείο

Περίληψη στο τέλος του άρθρου

Key words

Infection control
Needlestick injuries
Occupational accidents
Occupational exposure
Sharps injuries

Submitted 15.4.2014
Accepted 25.4.2014

Percutaneous exposure (PCE) to blood or body fluids is a major occupational health problem for health care workers (HCW).[1] Such exposures carry the potential for transmission of blood-borne pathogens from the patient to the HCW and are associated with substantial direct and indirect cost.[2,3] The US Centers for Disease Control (CDC) have estimated that approximately 385,000 PCE occur in US hospitals each year.[4] In the UK National Health System (NHS), needlestick injuries, the most common form of percutaneous exposure, represent the second most commonly reported adverse incident (17%).[5]

As some of these exposure incidents are avoidable, prevention of such incidents is crucial.[6] Several preventive strategies have been tried, ranging from educational interventions to specifically designed devices which minimize the risk of injury. In the US legislation has been introduced which requires that health care facilities use safer devices and maintain a log of percutaneous injuries by contaminated sharps.[7] Unfortunately, PCEs are generally underreported, which is an obstacle in designing and implementing preventive strategies.[8]

Data on the incidence rate of PCE from Greece are sparse. Of the two published studies from Greece one dates from 1999[9] and the other included only a small sample of exposures.[10]

The objective of the present study was to describe the epidemiology of PCE in a tertiary care general hospital in Greece. As most Greek hospitals lack an occupational health department, and the training of HCWs regarding safety issues is only occasional, it was hypothesized that

PCE incidence would be high, and that this study might be a useful basis for the introduction of appropriate prevention policies.

MATERIAL AND METHOD

An observational cohort study was conducted, with prospective data collection over a period of two years. It took place in the "Evangelismos" Hospital, Athens, from 1 July 2008 to 30 June 2010. The "Evangelismos" Hospital is a 950-bed tertiary care general hospital, the largest in Greece and one of the busiest. Some departments are affiliated with the University of Athens Medical School, specifically the intensive care unit (ICU), neurosurgery, and maxillofacial surgery. The hospital employs approximately 800 physicians and more than 1,000 nurses.

Standard definitions were used for PCE and for risk-posing body fluids.[1,11] HCWs were categorized into physicians, registered nurses, nursing students and trainees, cleaning staff and other staff. Professional experience for each HCW was categorized as <1 year, 1–5 years, 6–10 years and >10 years. The time that the incident occurred was recorded according to the shift, i.e., morning (7 am to 3 pm), evening (3 pm to 11 pm) and night (11 pm to 7 am). The location of the incident was described as emergency department, operating room, ICU, surgical wards, medical wards, laboratories and other sites (e.g., waste/laundry).

Since 2008, the infection control (IC) team has been prospectively collecting data on every exposure (percutaneous and mucocutaneous) as part of a protocol regarding the management of such incidents based on the guidelines of the European Centers for Disease Control (ECDC) and the CDC.[12,13] The data collection form includes detailed information about the HCW who suffered the exposure, the time, place and conditions under which the exposure occurred, and the status of the HCW and of the source patient regarding HBV, HCV and HIV. The management of the incident was also documented. The data were collected by the IC nurse in a face to face interview with the HCW, immediately or the next working day after the exposure incident. The paper data collection form was signed by both the IC nurse and the HCW and the data were subsequently entered on a spreadsheet (Excel, Microsoft). The original data in the forms were independently cross-checked with the data in the spreadsheet by two of the investigators. After each exposure first aid measures were taken, according to guidelines. If the source patient was known, his or her record was reviewed for evidence of HBV, HCV or HIV infection. Subsequently, both the HCW and the source patient were tested for HBV [HBV surface antigen (HBsAg) and antibody (anti-HBs) and anti-core antibody (anti-HBc)], HCV (HCV antibody) and HIV (HIV antibody and p24 antigen combined). All tests were performed in the Transfusion Department of the hospital, using the standard operating procedures for testing individual samples. These samples were given priority over routine samples, so that results were available on the same day, or the next morning when the incident occurred during the evening or night shift. Subsequent management, including risk assessment, was performed according to guidelines and with the involvement of an infectious diseases specialist physician.[12] Unvaccinated HCWs who sustained PCE from seronegative patients were encouraged to initiate HBV vaccination. The follow-up period was six months.

For benchmarking the results were compared with data from a large registry of sharps injuries, the EPINet, which is maintained by the International Healthcare Worker Safety Centre, University of Virginia, USA (http://www.healthsystem.virginia.edu/pub/ epinet/about_epinet.html), and with data from the Massachusetts Sharps Injury Surveillance System of the Massachusetts Department of Public Health (http://www.mass.gov/eohhs/gov/departments/dph/programs/health-stats/ohsp/sharps/) and publications from various different countries.

As the study analyzes self-reported exposure incidents, there will probably be a bias towards underestimation because of under-reporting.

Incident rates of PCE were calculated as the number of exposures per 100 full time equivalents (FTE) per year, as the number of exposures per 100 occupied beds per year, and as the number of exposures per 10,000 patient-days.[14] For each variable analyzed, only exposure incidents for which the relevant data were complete were taken into account. Frequencies and rates were compared using x^2 and Fisher's exact test. For all statistical calculations StatDirect v. 2.7.2 (StatsDirect Ltd, Altrincham, UK) was used.

The study was approved by the institutional Scientific Council (Document 711, 25.10.2010), which, according to the Greek Law, also serves as a Research Ethics Committee. The reporting of the present study conforms with the STROBE statement.[15]

RESULTS

In the 2-year period from 1 July 2008 to 30 June 2010, 374 PCE incidents were recorded. During this period the hospital employees included 820 physician FTE per year, 1,052 registered nursing staff FTE per year, 100 nursing student FTE per year and 255 cleaning staff FTE per year. The total number of patient days for the whole study period was 592,534, while the average number of occupied beds was 810.

The total incidence rate of PCE was 8.4 per 100 FTEs per year, or 23.1 per 100 occupied beds per year, or 6.3 per 10,000 patient-days. Table 1 presents the incidence rates for the study period by professional group.

Comparisons of PCE rates per 100 FTEs per year across professional categories revealed that nursing students had a significantly higher rate than all other categories, while cleaning staff had significantly lower rates. The rates were the same in physicians and registered nurses (tab. 1).

Table 2 presents data on the timing and location of the

Table 1. Incident rates of percutaneous exposure (PCE) by professional category over 2 years (confidence interval in brackets).

	Physicians n=135	Nurses n=163	Students n=51	Cleaning staff n=22	Total
PCEs/100 FTEs/year	8.2 (6.7–9.7)	7.7 (6.6–9.0)	25.5 (19.0–33.6)	4.3 (2.7–9.3)	8.4 (7.6–9.3)
PCEs/100 occupied beds/year	8.3 (7.0–9.9)	10.0 (8.6–11.7)	3.1 (2.3–4.1)	1.4 (0.9–2.1)	23.1 (20.1–25.5)
PCEs/10,000 patient-days	2.3 (1.9–2.7)	2.8 (2.3–3.2)	0.9 (0.6–1.1)	0.4 (0.2–0.6)	6.3 (5.7–7.0)

FTE: Full time equivalent

exposure and associated circumstances. The incidence rate of PCEs in medical wards was 11.5 per 100 occupied beds per year (95% CI: 9.4–14.1) while in surgical wards was 7.3 per 100 occupied beds per year (95% CI: 5.6–9.5), a difference which was statistically significant (two sided Fisher's exact test, $p<0.007$). The most common circumstances associated with a PCE were inappropriate sharps disposal and recapping. Only 59% of the PCEs occurred during the use of a device. The remaining PCEs either occurred after the use of a device (e.g., recapping) or were not associated with the use of a device (e.g., injury by sharp disposed in non-sharps container) (see tab. 2).

Table 2. Percutaneous exposure (PCE) incident characteristics (n=374).

Hospital location where exposure occurred	Number of incidents (%)
Medical wards	99 (26.5)
Surgical wards	53 (14.2)
Emergency department	45 (12.0)
Intensive care unit (ICU)	51 (13.6)
Operating theatre	81 (21.7)
Laboratories	14 (3.7)
Other	31 (8.3)
Timing of exposure	
Intravenous/arterial/intrathecal catheter placement	56 (15.0)
Subcutaneous injection	19 (5.13)
Arterial or venous blood sampling	53 (14.2)
Fingerstick glucose testing	29 (7.8)
Recapping needle	67 (17.9)
Injecting blood to collection tube	10 (2.7)
Using sharp device (non-hollow needle, scalpel, etc.)	65 (17.4)
Inappropriate sharps disposal	70 (18.7)
Other/Unknown	5 (1.3)
Shift during which exposure occurred (n=373)	
Morning shift	240 (64.3)
Evening shift	118 (31.6)
Night shift	15 (4.0)

In the study period 309 HCWs were involved in 374 exposures. Of these, 106 (34.3%) were physicians, 133 (43%) were registered nurses staff, 51 (16.2%) were nursing students, 17 (5.5%) were cleaning staff and 4 (1%) were other members of the staff. A number of HCWs were involved in more than one incident: 50 (16.2%) were involved in two, 14 (4.5%) in three and one (<1%) in four incidents. In 40.9% of repeat incidents, the involved HCW had less than one year of professional experience.

Of the 309 exposed HCWs, 246 (79.6%) had been immunized against HBV, 39 (12.6%) had not been immunized, 15 (4.8%) had not been immunized but proved to be immune to HBV, while 6 (1.9%) had not yet completed immunization at the time of the exposure. At baseline, one of the HCWs was HBsAg(+) and anti-e(+) and one was HCV(+). No data were available for 3 HCWs.

In 268 (72.4%) cases of PCE, the HCW was using gloves, in 38 (10.3%) wearing double gloves while in 64 (17.3%) not using any protective measures. Among the HCWs not using gloves, the activities most frequently associated with exposure incidents were recapping (32.8%), vascular catheter placement (23.4%) and fingerstick glucose testing (12.5%).

The source patients were known in 348 (93%) PCEs, and of these 16 (4.6%) were HBsAg(+), 30 (8.6%) were anti-HCV(+), and 5 (1.4%) were HIV(+). In 341 (91.2%) of the PCEs there was no intervention, except testing the source patient and the HCW either because the source patient was not infectious or the HCW had been immunized.

In 33 (10.7%) HCWs vaccination against HBV was initiated or continued or a booster dose was given. In 6 of these, HBV immune globulin was administered in conjunction with immunization. Of the 5 HCWs exposed to HIV(+) source patients, 2 refused prophylactic antiretroviral

therapy. No transmission of any of the above pathogens (HBV, HCV, HIV) via PCE has been documented so far in the study population.

Although this study used a data collection form different from that used in the EPINet registry, several fields were common to the two forms, and therefore a comparison of findings was made (tab. 3). It is apparent that the "Evangelismos" Hospital documented a significantly higher proportion of PCE among nursing students and in the clinical laboratory and the ICUs, and a significantly lower proportion in the operating and recovery rooms. PCEs were also more common in this study during blood sampling, vascular catheter placement, fingerstick glucose measurements and needle recapping. The EPINet hospitals recorded a higher proportion of PCE among the nursing staff, in the operating rooms, during injections and after use of a device (tab. 3).

Table 3. Comparison of characteristics of percutaneous exposure incidents (PCEs) in the "Evangelismos" Hospital with EPINet documentation.

	"Evangelismos" Hospital		EPINet*		
	n	%	n	%	p value
Professional group	371		1,375		
Pysicians	135	36.4	505	36.7	NS
Nursing staff	163	43.9	814	59.2	<0.0001
Nursing students	51	13.7	9	0.7	<0.0001
Housekeepers	22	5.9	47	3.4	0.03
Hospital location	343		1,680		
Patient's rooms	152	44.3	592	35.2	NS
Operating/recovery rooms	81	23.6	750	44.6	<0.0001
Clinical laboratory	14	4.1	25	1.5	0.007
Emergency department	45	13.1	159	9.5	NS
Intensive care units	51	14.9	154	9.2	0.012
Source patient identifiable	374		2,076		
Yes	348	93.0	1,960	94.4	NS
No/Unknown	26	7.0	116	5.6	
Contaminated device	374		2,070		
Yes	280	74.9	1,893	91.4	<0.0001
No/Unknown	94	25.1	177	8.6	
Injured was original user	374		2,032		
Yes	260	69.5	1,352	66.5	NS
No/Unknown	114	30.5	680	33.5	
Purpose of the device	222		1,639		
Injection, intramuscular or subcutaneous	19	8.6	545	33.3	<0.0001
Blood sampling	53	23.9	298	18.2	0.04
Suturing, cutting, etc.	65	29.3	673	41.1	0.0007
Vascular catheter placement	56	25.2	98	6.0	<0.0001
Fingerstick glucose measurement	29	13.1	25	1.5	<0.0001
Timing of injury	360		1,749		
During use of device	213	59.2	1,137	65.0	0.04
While recapping a needle	67	18.6	68	3.9	<0.0001
Device left inappropriately	70	19.4	236	13.5	0.004
After use before disposal	10	2.8	308	17.6	<0.0001

* EPINet: Exposure prevention information network (available at: http://www.healthsystem. virginia.edu/ pub/epinet/about_epinet.html)

NS: Non significant

DISCUSSION

In this study, a high incidence of PCE was recorded in a large tertiary hospital in Greece. The overall hospital rate for PCE was 23.1 per 100 occupied beds, compared with that reported from Massachusetts Sharps Injuries Surveillance for hospitals with >300 beds which was 25.2 per 100 occupied beds,[16] and that of EPINet hospitals which was 20.6.[17]

Two earlier studies on PCE in Greek hospitals have been published. The first was published in 1999 and reported 284 PCEs over a 6 year period,[9] while the second, published in 2007 reported 71 PCEs over a 29 month period.[10] The incidence rate of PCE in the present study was 8.4 per 100 FTEs per year in comparison to 2.4 and 2.1 per 100 FTEs per year in the previous studies from Greece. The first study, however, was conducted in 1990–1996, when healthcare workers had not been made fully aware of the concept of occupational safety and the perceived risk from a needlestick injury was low. As a result of this, underreporting could have been more widespread than it is now. The second study is recent, however it was undertaken in a hospital which operates outside the Greek NHS and in which as most of the admissions are elective, bed occupancy rates and workload, factors which influence adversely PCE incidence rates, are generally lower than in acute care NHS hospitals, such as the hospital in this study.

In terms of professional category, in this study the PCE rate for physicians was 8.2 per 100 FTEs per year, while the respective rate in a study from UK was 7.0,[18] in an Australian hospital 10.3,[19] and in a French national surveillance study 2.2.[20] A large Italian registry reported rates of between 1.3 and 11.8 among physicians, depending on the specialty.[21] The respective rate for registered nurses was 7.7 in this study, 8.8 in an Australian study,[19] 7.0 in France,[20] and between 3.7 and 14.1 in the Italian registry.[21]

Compared with the EPINet registry, a significantly higher proportion of PCEs occurred in nursing students in this study, while in registered nurses the proportion was significantly lower. The proportion of PCEs occurring in physicians was similar to the EPINet data (tab. 3).

Inappropriate sharps disposal and needle recapping were the two most common circumstances associated with PCE. A low proportion of PCEs were reported in the operating and recovery rooms in comparison with EPINet data.

The major limitation in this study is the lack of data on the magnitude of underreporting, which could result in underestimation of the incidence of PCEs. It can be assumed that in the study hospital underreporting would be frequent, as HCWs have not been systematically trained in the various infection control procedures and protocols, and a culture of safety is not actively promoted. For this reason also, comparison of PCE rates among hospitals needs to be undertaken cautiously, as underreporting is a powerful confounder, strongly affecting the accuracy of data.[22] Another limitation is the short observation period (two years), which does not allow for meaningful observations regarding trends. On the other hand, the data were collected prospectively, following a standardized protocol in a face to face interview with the HCW involved in each PCE incident, resulting in a dataset of high quality with <3% missing values per variable.

There are several possible reasons for the high rate of PCE recorded in the study hospital. Firstly, as there is no occupational health department, no formal training of HCWs in occupational health and safety issues is provided. HCWs receive no induction training in these issues when first employed, and the only form of safety training is in the format of short didactic sessions organized by the Infection Control Unit on an *ad hoc* basis.

Secondly, the use of safety or needleless devices is very limited, and thirdly, there are organizational issues such as a high workload and understaffing, especially of registered nurses. The relevant literature suggests that a heavy workload, as expressed by the bed occupancy rate, is associated with higher rates of adverse events, and needlestick injuries in particular.[23,24] Overall occupancy rates (in six month intervals) in the study hospital during the study period ranged from 83% to 87%, but the medical wards recorded very high bed occupancy (97%) while the surgical wards had lower rates (74%). This study documented PCE rates significantly higher in medical than in surgical wards, but it should be noted that there is no information on whether more procedures are performed on medical or surgical wards. Apart from bed occupancy rates, the activity index for the nursing staff was also high in this hospital.[25] Staffing levels are low in the hospital, as in most wards other than the ICU the nurse to patient ratio during the morning shift ranges between 1:8 and 1:12, with even less nurses during the evening and night shifts.

Of particular concern is the extremely high rate of PCE among nursing students in this study. This could be explained by the fact that, because of nursing staff shortages, students perform various tasks without proper supervision. Similarly, high rates of PCE were also observed among HCWs with <1 year of experience, regardless of professional group. Unfortunately, data regarding the years of professional experience of the non-exposed HCWs were not available for comparison.

The circumstances surrounding the exposure incidents are also of interest as the most frequent were device recapping and inappropriate disposal. This resulted in a relatively high percentage of incidents were the HCW who suffered the PCE was not the person who had used the sharp device. Injuries incurred during recapping comprised 17.9% of all PCE, while in the EPINet registry recapping accounted only for 3% of PCEs. Since these exposure incidents are totally avoidable, the necessity for better education of HCWs in sharps handling cannot be underestimated.

The study hospital is the largest in Greece and it operates as both an acute care hospital and a referral center. As a result the general workload and the numbers of procedures, operations, etc., performed are higher than in most Greek hospitals. The study data cannot therefore be generalized to represent other Greek hospitals, but they illustrate the need for safety training of HCWs in Greece.

In conclusion, a relatively high incidence of PCE has been documented in a large tertiary general hospital in Athens, in comparison to reports from large PCE registries. Taking into account possible underreporting, the real incidence could be even higher. Obvious causative factors are limited use of safety or needleless devices, inadequate education in safety issues, high workload and understaffing. It was also noted that a significant percentage of PCEs were avoidable, since they occurred during needle recapping or after inappropriate sharps disposal. These findings underscore the need for better, systematic education of Greek HCWs in safety issues.

ΠΕΡΙΛΗΨΗ

Διαδερμικές εκθέσεις υγειονομικού προσωπικού σε ελληνικό τριτοβάθμιο νοσοκομείο

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Αρχεία Ελληνικής Ιατρικής 2014, 31(6):718–724

ΣΚΟΠΟΣ Οι διαδερμικές εκθέσεις αποτελούν μείζονα επαγγελματικό κίνδυνο για το υγειονομικό προσωπικό. Ωστόσο, τα δεδομένα σχετικά με την επίπτωση των διαδερμικών εκθέσεων στα ελληνικά νοσοκομεία είναι ελάχιστα. Στην παρούσα μελέτη περιγράφεται η επιδημιολογία των διαδερμικών εκθέσεων σε ένα τριτοβάθμιο γενικό νοσοκομείο στην Ελλάδα και συγκρίνονται τα δεδομένα με εκείνα άλλων χωρών. **ΥΛΙΚΟ-ΜΕΘΟΔΟΣ** Πρόκειται για μια μελέτη κοορτής με προοπτική συλλογή δεδομένων για όλες τις διαδερμικές εκθέσεις που αναφέρθηκαν, σε ένα νοσοκομείο 950 κλινών σε περίοδο δύο ετών. Η συλλογή των δεδομένων πραγματοποιήθηκε με προσωπικές συνεντεύξεις του υγειονομικού προσωπικού που ανέφερε το επεισόδιο έκθεσης με τη χρήση προτυποποιημένου εντύπου. **ΑΠΟΤΕΛΕΣΜΑΤΑ** Καταγράφηκαν 374 επεισόδια έκθεσης. Η συνολική επίπτωση των διαδερμικών εκθέσεων ήταν 23,1 ανά 100 κατειλημμένες κλίνες ανά έτος. Η υψηλότερη επίπτωση καταγράφηκε στους σπουδαστές Νοσηλευτικής (25,5 ανά 100 μονάδες ισοδύναμου πλήρους απασχόλησης ανά έτος). Η συχνότητα των επεισοδίων έκθεσης ήταν σημαντικά μεγαλύτερη στις παθολογικές κλινικές σε σύγκριση με τις χειρουργικές κλινικές. Οι συχνότερες συνθήκες που οδηγούσαν σε έκθεση ήταν η λανθασμένη απόρριψη αιχμηρών αντικειμένων (18,7%) και η εκ νέου κάλυψη της βελόνας (17,9%). Σε ποσοστό 29% των επεισοδίων έκθεσης ο υγειονομικός εκτέθηκε από αιχμηρό αντικείμενο, το οποίο χειρίστηκε ή απέρριψε λανθασμένα κάποιος άλλος. **ΣΥΜΠΕΡΑΣΜΑΤΑ** Η επίπτωση των διαδερμικών εκθέσεων στο νοσοκομείο που μελετήθηκε ήταν υψηλή σε σύγκριση με προηγούμενες αναφορές από άλλα ελληνικά νοσοκομεία, αλλά και σε σύγκριση με διεθνή δεδομένα. Οι προφανείς αιτίες είναι η έλλειψη εκπαίδευσης σε θέματα ασφάλειας, η περιορισμένη χρήση συσκευών ασφάλειας, ο υψηλός φόρτος εργασίας και η υποστελέχωση σε υγειονομικό προσωπικό των ελληνικών νοσοκομείων.

Λέξεις ευρετηρίου: Έλεγχος λοιμώξεων, Επαγγελματικά ατυχήματα, Επαγγελματική έκθεση, Συμβάματα από αιχμηρά αντικείμενα

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