Needlestick and sharps injuries as occupational hazards when manipulating fish in environmental biomonitoring studies

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RESUMO

Acidentes com agulhas e materiais com perfurocortantes têm sido estudados em diversas áreas de saúde diferentes, e são um importante risco ocupacional. No entanto, pouco é relatado a respeito estas lesões em biólogos e especialistas em meio ambiente. Uma verificação completa da literatura foi realizada a fim de observar relatos deste tipo de acidente em diversos campos de interesse. Relatos também foram obtidos em um grupo de pesquisa especialista em biomonitoramento no Brasil, indicando que estes e outros tipos de acidentes com materiais perfurocortantes são um perigo inerente para a saúde e expõem esses profissionais ao risco de contrair várias doenças infecciosas graves, sendo claramente um grande problema de saúde ocupacional em profissionais que trabalham com biomonitoramento, como biólogos e especialistas em meio ambiente.

Palavras-chave: Acidentes com agulhas e materiais perfurocortantes, peixe, risco ocupacional, monitoramento ambiental.

ABSTRACT

Needlestick and sharps injuries (NSI) have been studied in several different healthcare fields, and are an important occupational hazard. However, little is reported about these injuries in biologists and environmental specialists. A comprehensive literature check was conducted in order to observe accounts of NSI in several fields. Accounts were also obtained from a biomonitoring research group in Brazil, indicating that NSI and other sharps injuries are an inherent health hazard and leave these professionals at risk of contracting several serious infectious diseases, and is clearly a main occupational health problem in biomonitoring professionals such as biologists and environmental specialists.

Keywords: Needlesticks and sharps injuries; fish; occupational hazards; environmental monitoring.

INTRODUCTION

Needlestick injuries (NSI) can be a life threatening event for many health professionals and healthcare students that are involved with either human or animal healthcare, as pointed out by several studies throughout the world (SMITH; LEGGAT, 2005; EBRAHIMI; KHOSRAVI, 2007; LEGGAT; SMITH; SPEAR, 2009). It is important to reduce these types of events in these fields, since NSI may lead to transmission of infectious diseases, as well as wounds resulting from the physical contact of needles and other sharps on human skin (LEGGAT; SMITH; SPEAR, 2009).

However, what is usually overlooked is the fact that not only professionals working in healthcare fields are exposed to these events. Several personnel from other fields of interest are also inherently exposed to these types of hazards, and some in particular attract attention, such as biologists and environmental specialists. These specialists in many cases deal with animals in the field and in the laboratory, and are at risk for NSI and the disease transmissions infections that may result.

Aquatic biomonitoring programs, in particular, have been increasingly implanted due to concerns regarding environmental contamination by organic compounds and metals in these ecosystems (FRANCIONI et al, 2005; HAUSER-DAVIS et al, 2012). Since environmental monitoring based exclusively on chemical analyses of water and sediments is not suitable for the assessment and prediction of effects of aquatic contaminations, several of these programs use fish and invertebrates as sentinel organisms (BARSIENE et al, 2006).

In this context, the aim of this paper was to investigate the occurrence of needlestick injuries and the occupational hazards of handling and manipulating fish inserted in the scope of environmental monitoring programs, and, to the best of our knowledge, is the first to report accounts of these occurrences in Brazil.

MATERIAL AND METHODS

Accounts were obtained from members of a biomonitoring research group from Rio de Janeiro, Brazil. The total number of researchers that belong to this group varies, but usually comprises about 20 people, including biologists, chemists, biochemists and chemical and environmental engineers. The researchers (n=15) answered a comprehensive questionnaire regarding type and frequency of NSI injuries during several fish analyses, including organ removal and fish manipulation.

RESULTS AND DISCUSSION

About 50% (Total n=13) of the present group suffered NSI while manipulating fish specimens using scalpels and needles to dissect the animals and the manipulation of small electric and/or manual saws, used to open the fish's cranium and reach the brain. Several of these injuries were also due to fish characteristics themselves, such as the presence of sharp spines along ventral or dorsal fins. When asked, 3 interviewed subjects reported both types of injuries, caused by needlesticks and animal parts, while 3 individuals reported injuries only by needlesticks.

The first step in biomonitoring programs is an accurate weighing and measurement of the animals, followed by sample removal. Briefly, for blood sampling, the live fish is usually placed on a bed of crushed ice under dimmed light or anesthetized, and a syringe is used for the blood sampling (RUSSELL, 1964; CALDWELL et al, 2006). For organ and tissue removal, the usual procedure is to gut the fish with sharp scissors, remove the liver, kidneys and other organs of interest, remove axial muscle tissue with scalpels if necessary and, in some instances, remove the brain, in which usually a small saw is used to open the top of the cranium, and needles are used to separate the brain from bone (KIRBY et al, 2000; BUET et al, 2006; OLIVEIRA et al, 2007). The questioned research group follows these same procedures when procuring the fish samples. As evident from this description, extensive handling and manipulation of these animals is necessary in order to obtain the samples of

interest, evidencing the risks of NSI and exposure to several infectious diseases transmitted by fish to humans.

Among these diseases, many zoonotic diseases are know to be of fish origin, including several that can be transmitted simply by dermal contact with infected fish or contaminated water, in which the dermal exposure definition is "the introduction of infectious agents into open wounds or abrasions through handling infected fish or infected water" (NEMETZ; SHOTTS, 1993). Fortunately, the only consequence of the injuries sustained by the interviewed group were slightly inflamed wounds, which subsided after a couple of days.

Dermal contact with infected fish has been shown to be a source of contamination of several types of bacteria and virus, and some of these can cause severe symptoms in humans. Several infectious diseases are transmitted by fish or contaminated water (LEIBOVITZ, 1980; THOEN et al, 1981; SHORTS, 1987; ACHA; SZYFRES, 1989; NEMETZ; SHOTTS, 1993; JOHNSON-DELANY, 1996). These include:

- Erysipelothrix - *Erysipelothrix insidiosa* has been reported in humans contaminated by handling fish. It is mainly an occupational disease affecting fishermen. The organism can be found on the surface of the fish and produces skin lesions. *Erysipelothrix* infection is almost invariably introduced through minor skin wounds. Local infection by these bacteria most commonly occurs on the hands, and sometimes local lymphangitis and lymphadenitis may occur.
- *Nocardia* - no known cases in humans but the potential risk exists. Human symptoms include swelling over bony prominences or open wounds and abrasions, three to four weeks after the bacterium enters the skin. An abscess develops, that may be filled with pus and may ulcerate and scar. Swelling of the lymph nodes may occur.
- *Klebsiella* - reported cases in humans. Human symptoms include urinary tract infections and septicemia.
- *Edwardsiella* - reported cases in humans. Symptoms include acute gastroenteritis, wound infections, septicemia, peritonitis and meningitis.
- Salmonella - reported cases in humans. Human symptoms include abdominal pain, acute gastroenteritis, bloody diarrhea, nausea, vomiting fever, meningitis, urinary tract infections and osteomyielitis.
- *Mycobacterium* - reported cases in humans. Among the bacterial diseases, mycobacteriosis is certainly of major concern. Mycobacterial infections are certainly among the major zoonoses that can be transmitted by fish. *Mycobacterium marinum*, *Mycobacterium fortuitum* and *Mycobacterium platypolcitis* have been associated with fish and human disease for many years. Skin ulcers caused by *Mycobacterium marinum* have been reported, and infection by this bacterium is characterized after several weeks of incubation by papular lesions, usually on the fingers or hands that evolve to dark suppurative lesions. In infected fish, granulomatous lesions are usually observed.
- *Candida* – reported cases in humans. The organism can be found on the surface of the fish and produces skin lesions. Human symptoms include white plaques on oral mucosa; skin-fold dermatitis and immunocompromised patients are susceptible to hematogenous spread to eyes, kidneys and bones.

Dermal contact with infected water has also been shown to be a source of contamination of bacteria and virus, including the above mentioned Mycobacterium, *Nocardia*, *Edwardsiella*, as well as *Vibrio* and *Pseudonomas*. The former symptoms in humans include watery feces with mucus and a mild fish smell, vomiting, stomach cramps and dehydration, while the latter symtoms has not yet been reported in humans, but the potential risk exists, which can cause Melioidosis, an uncommon disease in humans with a wide range of clinical manifestations from unapparent infection to a rapid fatal septicemia.

Besides the risk of contracting an infectious disease another important risk is involved in the direct handling of fish, by direct skin and mucosal contact, is an increase in sensitization which may result in full blown allergy, including urticaria, asthma and anaphylaxis, due to direct skin

contact during direct handling. This has increased dramatically in the general population, as a consequence of the increased consumption of seafood (REE-KIM; LEHRER, 2004).

Needle use in other fields is high-risk (SMITH, 2005), and this seems to be the case in biomonitoring studies as well, in which, according to the accounts of the investigated group of researchers, NSI are very likely to happen with each fish collection and sampling, due to the high use of needles and scalpels.

One noteworthy observation is that, according to the species of fish being manipulated, the risk for NSI and, consequently, dermal contact, can increase or decrease. An example of this is the presence of spines in the ventral fins of the mullet species *Mugil liza*, routinely analyzed by the investigated group, which has been found to account for most NSI to fingers while manipulating these fish, even more so than needles and scalpels. West-Nile tilapias, on the other hand, possess no such spines, but do show several dorsal spines in the first dorsal fin, also showing the risk of NSI and dermal contact by spinal contact.

Brain removal, on the other hand, independent of species, has been the cause of several injuries to hand and fingers, due to the fact that the most effective instrument to open the cranium top of the fish is a small saw (manual and/or electric). This, allied to fish shape, size and slipperiness, has caused different frequencies of injuries in the investigated group, also proving to be an important variable. The manipulation of these instruments often causes extreme injuries to fingers and hands (HAUSER-DAVIS, personal communication).

Several protective measures can be observed in order to minimize NSI and the consequent dermal contact to which biologists and environmental specialists are exposed to while manipulating fish (CANADA DEPARTMENT OF FISHERIES, 2004; WEESE; JACK, 2008). These include always keeping a sharps container nearby during fish sampling and manipulation, never overfilling the sharps container, and never attempting to re-sheathe the needles, always discarding them in the sharps container immediately after use. Also, when in the field, especially for blood collection from fish, it is suggested to spread a fine mesh net under the entire work area, in order to prevent loss of supplies (especially sharps), that may accidentally drop while sampling, and later accidentally cause injuries to personnel and/or the animals.

Other simple procedures are common to any laboratory, such as the use of protective clothes and gloves and breathing masks in order to avoid the kinds of contaminations and health risks that are a direct occupational hazard of these fields of expertise and study. Thus we agree with other studies (SMITH, 2005) that show that training and focus of the personnel involved should be the main theme when conducting these types of studies, and that they should focus on these procedures, of handling needles and other sharps.

As this kind of potential hazard is present in all personnel of environmental monitoring programs that have direct contact with fish, an enforcement of compliance with regulations (e.g. use of protective clothing, periodical training) should be paramount, to prevent incidents of the kind described in this paper.

Potential contamination by several infectious diseases can be caused by NSI and not limited to needles alone, because manipulation of other sharp instruments or mucous membrane exposure to infected body fluids can also result in the transmission of infectious diseases (FERGUSON, 1992). This conclusion was initially drawn regarding human contamination, but can also be applied to the manipulation of fish specimens, since the use of needles, scalpels and saws are routinely used in laboratory manipulation of these animals in order to obtain tissue and organ samples for chemical/biochemical analysis in environmental monitoring programs.

Importantly, in order to obtain a representative picture of environmental impacts in aquatic ecosystems, a high number of samples are required. Translating this affirmation into numbers reveals that, in some instances, personnel from the investigated group have to

manipulate as much as 50-70 animals per-

day (HAUSER-DAVIS, personal communication). This, obviously, suggests that the exposure time to these organisms can be very high and that factors that may increase NSI frequency and consequent dermal contact include pressure for the professional too finish the analysis as quickly as possible, which may lead to stress, and, of course, the factor tiredness is always an issue, commonly leading to mistakes.

During the analyses and handling of the fish specimens, all personnel wear latex gloves, which are adequate for protection against direct dermal contact with the animals and protective clothes. However, obviously, these gloves are very frail, and if a sharp such as a syringe or a scalpel rips or tears them, dermal contact is at high risk of occurring, leading to the risk of contracting one or more of the infectious diseases described above.

Several authors discuss different strategies to prevent infections due to sharp injuries, including training personnel and reducing invasive procedures (WICKER et al, 2008). The latter strategy, however, cannot be applied in the case in question, since the main objective of capturing the fish and manipulating them in a laboratory is to obtain samples, tissues and organs that cannot be obtained without making use of invasive procedures.

CONCLUSIONS

Overall, this study has shown that NSI and consequent dermal contact that may follow represent a serious occupational hazard for professionals dealing with fish sampling in environmental monitoring programs, in which invasive procedures are necessary in order to obtain samples for chemical/biochemical analysis.

Even though certainly all personnel involved in these types of activities use gloves and protective clothes and are well trained, NSI still happen very often. Many of these NSI are due to the nature of the specimens involved: many fish possess spines on dorsal and ventral fins; fish are also very slippery even after washing with water and maintaining a firm hold on some species is very difficult, leading to not very firm manipulation of sharps on the fish; and several fish species possess exceptionally hard craniums in which, in case of the need for brain removal, the manipulation of small saws often causes extreme injuries to fingers and hands. Therefore, the use of latex gloves does not protect from dermal contact if NSI has occurred while manipulating the fish and the NSI risk in manipulating fish is quite high.

As such, to reduce NSI exposures in this field, education, training and simple protective measures are encouraged when handling fish specimens in the lab or in the field. It is also important to be aware of the risks of infectious transmission diseases by fish to humans, and to remain vigilant for any symptoms that might indicate these types of contamination.

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