
MALIGNANT CELLS

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OCCUPATIONAL SETTING

Workers at risk include: (1) laboratory workers who handle malignant cells during the performance of *in vitro* and *in vivo* research, (2) histology and pathology workers involved in the preparation and processing of neoplastic tissues, (3) medical and nursing staff involved in surgical procedures (i.e. aspirates, biopsies, resections) on cancer patients; (4) surgical scrub personnel handling sharp instruments contaminated with malignant cells; and (5) housekeeping workers (especially those in cancer research areas) exposed to sharp objects contaminated with malignant cells.

EXPOSURE (ROUTE)

The occupational risk of cancer occurring in humans from exposure to malignant cells is not well recognized, owing to the few cases

reported in the medical literature. Based on these reports, the most likely route of occupational transmission involves needlestick or sharp object injuries whereby malignant cells are cutaneously injected or possibly implanted into an open wound. This risk is best understood by the well-described occurrence of occupational transmission of infectious diseases such as HIV, hepatitis B and hepatitis C via needlesticks or other sharp objects (i.e. surgical instruments, histologic tissue cutters, broken capillary tubes and pipettes).

There are currently more than 8 million healthcare workers in the USA in hospitals and other healthcare settings. While precise data are not available with respect to the actual number of annual needlestick injuries or other percutaneous injuries among healthcare workers, it is estimated that 600 000–800 000 occur annually and that half of these go unreported.¹ It is estimated that as many as 2800 injuries may occur each year from handling glass capillary tubes.²

A review of studies reporting needlestick injuries found that 34–50% of health care workers were injured and that 10–70% of those injuries were due to recapping of needles.³ Studies of hospital workers have shown that the highest incidence of needlestick injuries occurs in housekeeping personnel (during trash disposal) and laboratory and nursing personnel (during needle disposal or recapping).^{4,5} Pathologists and surgeons have also been shown to be at increased risk for cutaneous injuries from sharp instruments and needlesticks (especially involving the distal fingers of the non-dominant hand) during operative procedures.^{6,7} Although the incidence of cutaneous injuries resulting from sharps contaminated with viable cancer cells is unknown, it probably represents only a small fraction of the cutaneous injuries incurred by potentially exposed workers.

PATHOBIOLOGY

Transplantation of foreign human tissue to a healthy recipient normally leads to an immune response resulting in destruction of the transplanted tissue (rejection).⁸ Southam et al,^{9,10} showed that normal recipients given subcutaneous injections of human cancer cells responded with a marked local inflammatory reaction and a rapid complete regression of the cancer implants within 3–4 weeks. In contrast, cancer cell injections given to advanced cancer patients showed little or no acute inflammatory reaction; the cancer cells typically grew for 3 weeks or longer before regression, and in some recipients growth continued beyond 6 weeks.¹⁰ One recipient exhibited local recurrence of tumor growth even after three excisional biopsies, and another recipient had lymph node metastasis.⁹ In another study, local cancer growth occurred in two patients who received small allogeneic tumor implants as part of an immunotherapy protocol for advanced cancer.¹¹

Scanlon et al¹² reported that some patients with advanced cancer have even tolerated tissue grafts from other animal species. Growth of transplanted cancer cells has also been reported to occur in healthy immunocompetent individuals. In one case, death from metastatic disease was reported in a woman who received a small melanoma graft taken from her daughter as part of an immunotherapy protocol.¹² In another case, a healthy 19-year-old laboratory worker developed an actively growing adenocarcinoma of colonic origin on her hand following a needlestick injury. At the time of the injury, only a small superficial wound was noted, with no apparent injection of the cancer cell suspension. The tumor, which was widely excised after 19 days, showed no evidence of an inflammatory response or necrosis. The worker was noted to be free from recurrence 4 years after the injury.¹³

The occurrence of transplanted cancer cell growth and metastasis in some individuals appears to be related to alterations of immune functioning. Rejection of foreign tissue depends upon recognition of major cell surface histocompatibility (HLA) antigens and involves both cell-mediated and humoral immunities.⁸ The most important cell-mediated reactions involve both CD4⁺ T-helper cells and CD8⁺ cytotoxic T-cells, which play a crucial role in the recognition of foreign tissue cells and regulation of the immune response.⁸ Humoral immune reactions to transplantation antigens appear to be mediated by antibodies formed against foreign class I and class II HLA antigens.⁸ Therefore, HIV/AIDS patients, other immunocompromised individuals and those on immunosuppressive medications (i.e. steroids, cyclosporine, azathioprine) may be at increased risk for developing viable neoplasms when exposed to malignant cells. The occurrence of cancerous growth in two apparently healthy immunocompetent adults is not well understood. Immune tolerance, lack of an immune response to specific antigens, under these conditions may be due to certain mechanisms

which allow the tumor cells to escape immunosurveillance, such as loss or reduced expression of histocompatibility antigens, shedding or modulation of tumor antigens, and production of immunosuppressive factors.⁸

TREATMENT

Injuries should be medically treated as with other needlestick or cutaneous injuries. In addition, the injury site should be periodically evaluated for any tumor growth for at least the ensuing 3–4 weeks (immunocompromised individuals may require longer follow-up). If tumor growth occurs, wide excision of the tumor with close follow-up should be considered. This treatment was apparently effective in at least one of the reported cases.¹³

MEDICAL SURVEILLANCE

All percutaneous injuries should be handled in accordance with the OSHA Bloodborne Pathogens Standard, which covers workers occupationally exposed to unfixed human tissues or blood products.¹⁴

PREVENTION

All non-essential sharps should be eliminated where possible, especially in laboratory situations. The risk of needlestick injury can be reduced by eliminating all needle recapping and non-essential unprotected needle use; needleless or protected needle devices should be used where possible.¹⁵ Where the use of needles or sharp instruments is indicated, workers should be trained in the safe techniques for handling and disposal (i.e. using puncture-resistant containers) of these objects. Additionally, workers should be encouraged to report all needlesticks and contaminated cutaneous injuries so that appropriate postexposure treatment can be given and so that the incident

can be studied to prevent similar accidents in the future. Further, worker education and training, needle handling and sharps disposal should be conducted in accordance with the OSHA Bloodborne Pathogens Standard and NIOSH recommendations to reduce the likelihood of worker injuries.^{1,14–16}

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