tithrombin deficiency. Although recurrent thromboembolism may be more likely in these patients,[9] most centres do not advocate lifelong anticoagulation after a first thrombotic episode unless the initial event was life threatening or, in some cases, where there is antithrombin deficiency.[8] These recommendations may be modified in light of Kearon and associates' findings,[5] which showed that patients with a first idiopathic thrombosis benefited from extended anticoagulation therapy whether they had any underlying biochemical risk factor or not. The factor V Leiden mutation has not been found to be associated with an increased risk of venous thrombosis after hip- or knee-replacement surgery;[6] again, this suggests the importance of clinical circumstances.

Extended anticoagulation therapy, although clearly beneficial in some patients, requires continual monitoring and is not without the risk of minor or major hemorrhage.[1–5] Studies now in progress are evaluating the role of lower intensity long-term oral anticoagulation therapy,[10] which is hoped to provide ongoing protection against recurrent thrombosis, but at a lower cost of hemorrhagic complications.

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Radiofrequency radiation exposure and other environmental concerns

Ron House, MD

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Environmental and occupational health risks are increasingly a focus of public concern, and busy physicians are now commonly faced with requests for information about the consequences of exposure to chemicals as diverse as dioxin, lead, mercury and pesticides, or to physical agents such as radiation, noise and vibration. Indeed, the results of a recent survey indicated that Canadians rate the medical community as their most trusted source of environmental health information.[1] Family physicians surveyed in Ontario[2] reported that they had fielded questions in the last year related to exposure to specific types of radiation; of those who responded, 88% had been asked about exposure to sunlight, 67% about radiation (presumably ionizing), 40% about electromagnetic fields and 6% about radon.[2] However, these physicians gave low ratings to their own knowledge of most environmental health issues. Clearly, physicians need to be better prepared to respond to the environmental health concerns of their patients and communities.

The research letter by Dr. Artnarong Thansandote and colleagues (page 1311)[3] is helpful in this regard. It presents a clear, succinct summary of an investigation undertaken to address a community's concern about exposure to radiofrequency (RF) radiation. The increased use of cellular telephones has resulted in the installation of numerous radio transmitters to relay calls, thus giving rise to concerns about the emission of RF radiation. Thansandote and colleagues made over 160 measurements of RF power-density levels in areas accessible to teachers and students in 5 Vancouver schools: 3 with a cellular base-station antenna on or near the

school property and 2 without an antenna in the vicinity. Their finding that all levels were well below permissible limits should help to allay concerns about this issue.

The electromagnetic spectrum represents a continuum from high-frequency gamma rays and x-rays through radiation of progressively lower frequencies, including ultraviolet, visible and infrared light, RF radiation, and very-low-frequency and extremely-low-frequency radiation (including the 60 Hz frequency associated with power lines). For any type of radiation, the higher the frequency and shorter the wavelength, the higher the quantum of energy. Gamma rays and x-rays have sufficient energy to ionize tissue. Non-ionizing radiation, which has lower energy, will not result in ionization but can still cause the vibration and rotation of molecules.

Public concern about RF radiation exposure may be related to a similar highly publicized concern about extremely-low-frequency radiation from power lines and electrical appliances and their possible association with cancer, particularly leukemia and brain cancer. Both RF and extremely-low-frequency radiation are non-ionizing, but a major difference between these bands of the electromagnetic spectrum is that RF radiation, especially the microwave portion, can produce thermal effects in tissue.

RF radiation is generally defined as including frequencies from 100 kHz to 300 GHz; this includes microwaves, which encompass frequencies from 10 MHz to 300 GHz. RF radiation has many industrial and consumer applications, as in sealing and heating equipment, medical diathermy, AM, FM and amateur radio, television, air-traffic control, mobile radar units, and a variety of telecommunications devices, including cellular telephones. Although a large spectrum of frequencies is included, exposures are usually grouped under the generic term "RF exposures."

Although RF radiation levels in the community have increased markedly over approximately the last half-century, they are generally still well below permissible standards. However, exposures in publicly accessible areas close to sources of RF radiation may occasionally exceed safety limits for environmental exposure.[4] Thansandote and colleagues dealt with a small sample in a single community; additional surveys of RF radiation exposure in other areas would be helpful. Some occupational exposures, as in the vicinity of industrial RF sealing machines, may be excessive and require mitigation.[5] These standards (derived by applying a safety factor to thresholds for subtle thermal effects) vary according to frequency, which influences tissue penetration of RF radiation.

Thermal effects in animals include superficial and deep skin burns, subcutaneous tissue destruction, cataract formation and testicular damage. These effects have occurred from acute high exposures well in excess of permissible exposure limits. There is little information on RF radiation effects in humans, but the present consensus is that very-high-intensity exposures are required to produce detectable eye injuries in humans.[6] Although thermal effects are well known, there is some controversy surrounding the possibility of nonthermal effects from lower, longer-term exposure — in particular, the neurobehavioural effects described in the Eastern European literature.[7] There have also been media reports of testicular cancer in police officers associated with the use of radar guns and of brain cancer in people who use cellular telephones. These issues will probably require epidemiologic studies to resolve them. However, it seems unlikely that exposure levels below the permissible limits — which are in turn below the threshold for thermal effects — would have any carcinogenic or behavioural effect.

The issue of RF radiation is similar to many other questions that arise with respect to occupational and environmental exposures. Despite the science that underpins our knowledge, there are still areas of uncertainty — especially about long-term, low-level effects. We are thus confronted with the challenge of communicating risk despite uncertainty. In such an arena the traditional skills of the physician are useful. Covello[8] indicated that trust and credibility in the context of risk communication depend on a number of factors, including empathy, expertise, openness and commitment. Given the public's interest in environmental health issues, physicians can expect to be asked more frequently about the risks of environmental and occupational exposures. This argues for increased attention to occupational and environmental medicine in medical school curricula and in continuing medical education. In addition, primary care physicians should consult with specialists in occupational medicine and in community medicine when they encounter difficult occupational or environmental health issues.

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