
Aggression – from Basic Science to Real Life

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Webster's Dictionary defines aggression as "a forceful action or procedure especially when intended to dominate or master...destructive behavior or outlook especially when caused by frustration." Very often aggression deteriorates into violence that is the physical expression of aggressive impulses. Despite intuitive knowledge that

aggression has to do with roles and actions associated with the male gender, very few epidemiologic studies of violence among adult men and women provide population-based data on this phenomenon.

In 1998 a random sample of households surveyed in the rural

United States reported that 5% of men and 3% of women had experienced physical violence in the previous year [1]. In Israel, the Central Bureau of Statistics reports that violent crimes tried in the criminal courts more than doubled from 15,232 cases in 1992 to 32,159 in 2001. In addition, during the year 2000 more than 420,000 adults in this country were victims of a crime, mainly theft or physical violence resulting in an annual rate of 17 offenses committed against every 100 adults in the country [2]. The great majority of these crimes and especially those involving violence were committed by a male perpetrator, hinting at the role of testosterone.

The testosterone-serotonin link

The complex interaction of cultural, ethnic, gender and biological factors influencing aggression and violence have been studied systematically since the 1970s. Already in 1976 Bernard [3] reported that testosterone affects frog-killing behavior in female rats through an increase in brain norepinephrine and serotonin. In the decades since, the biological aspects of violence were researched – with the focus shifting in the 1980s to serotonin [4] and in the 1990s to the interaction between testosterone and serotonin [5].

In this issue of *IMAJ*, Birger et al. [6] review the link connecting serotonin, testosterone and aggression. They carefully walk the reader through the effects of testosterone on young boys and men, demonstrating a clear association between excess aggressive behavior and testosterone. We are then presented with evidence linking low central nervous system serotonergic activity and aggression, and finally the link between these two substances is reviewed. The authors implicate frustrated dominance-seeking behavior as the pathway leading to testosterone-serotonin-associated aggression.

Implications

The great difficulty in establishing a treatment protocol based on the testosterone-serotonin link and aimed at reducing violent aggression is the discrepancy between basic science and animal models on the one hand and observations in human subject on the other.

Neuroendocrine investigations have demonstrated that male-typical aggression is testosterone-dependent but it needs characterizing as to the modulating effects of serotonin. Inter-male aggression among monkeys and rats is reduced by 5-HT1 agonists, but estrogens and androgens differ categorically in their ability to confer a restrictive environment for attenuation of aggression [7]. In rats, it was further elucidated that estrogens produce a more restrictive environment than androgens for inhibition of male-typical aggressive behavior [8]. In adult male rhesus macaques, injurious behavior was reduced by the administration of cyproterone acetate probably through reductions in both serum testosterone and cerebrospinal fluid 5-HIAA levels [9].

In humans, recent studies directly tested the effects of exogenous supraphysiologic doses of testosterone on aggression in normal men. In one such study a slight increase was noted in

aggression and manic symptoms but these effects were not uniform and most individuals showed little psychological change [10]. This was supported by a second study demonstrating that impulsivity, prior to the introduction of exogenous testosterone, was the only variable that predicted aggression over and above testosterone levels [11].

Conclusion

The complexity of aggression requires further studies that will help clarify the roles of hormonal and monoaminergic agents as well as their links to each other. It is clear, however, that violence is both culturally and biologically mainly a male-related issue. The frustration of dominance-behavior, as suggested by Birger et al. [6], may be a good starting point for future research. It also complements recent findings across cultures that children with less physical affection and more neglect develop into aggressive adolescents. Massage therapy (through physical stimulation) increases serotonin levels, decreases aggressive behavior and increases the empathy of these adolescents [12]. Clearly, we need to touch our children lovingly in order to start a change in the overwhelming violence around us.

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