THE MIND AND THE IMMUNE SYSTEM

RUDY E. BALLIEUX

Department of Medical Physiology and Sports Medicine, Faculty of Medicine, Utrecht University, P.O. Box 80043, 3508 TA, Utrecht, The Netherlands

ABSTRACT. Stress-induced brain-mediated immunoregulation is effected by two pathways: autonomic outflow and (neuro)endocrine outflow. Particular attention is given to the interaction-effects of chronic and acute stress. Recent data have established that cells of the immune system produce neuro-peptides and hormones. In concert with cytokines released by these immune cells the brain can be informed on the nature of ongoing immune activity. The significance of conditioning of immune responses is discussed.

Key words: conditioning, neuroimmunomodulation, psychoneuroimmunology, stress

The essential issue is whether it is possible to strike a sensible balance between psychological factors and biological factors in the understanding and management of disease

Norman Cousins

1. INTRODUCTION

The nervous system and the immune system have a fundamental biological function in common. Both systems have the capacity to act as intermediary in the contact of the individual with the often hostile and threatening "Umwelt." The activation of the nervous system by cognitive stimuli from this outer world, leads to the release of chemical messengers (neurotransmitters, peptide hormones) which can change bodily functions. As suggested by Blalock in 1984, the stimuli sensed by the immune system are of noncognitive nature and include specimens such as viruses, bacteria, toxins and aberrant (tumor) cells which cannot be recognized by the nervous system. The activation of the immune system by these noncognitive stimuli also gives rise to the release of chemical messengers (lymphokines and cytokines) which can modulate bodily functions.

The immune system and the nervous system therefore show a considerable degree of congruence and have several characteristics in common. Just to mention three: communication at a distance, the capacity to develop memory, and the use of chemical messengers to transfer messages to target cells. This has lead to the assumption that the two systems are function-
ally connected. Studies addressing this issue have generated interesting data which confirm that a functional interdependence of the mind and the immune system exists. Some aspects will be discussed in the framework of this special issue on Mind-Body interaction.

2. STRESS AND IMMUNE RESPONSE

The modulation of immune function by psychosocial factors has been extensively documented (see also the Introduction by Bergsma to this volume). It is obvious that perception of the event is crucial in the process of brain-mediated immunoregulation. The changes in immune responses are effected by the central nervous system via two pathways: autonomic outflow and (neuro)endocrine outflow. Both may change as a result of a psychosocial stimulus resulting in changes in neurotransmitter and hormone profiles. Since cells of the immune system carry surface-bound receptors for a great number of hormones, neuropeptides and neurotransmitters, changes in autonomic and/or neuroendocrine activities may potentially modify the functional properties of these cells. The direction of the changes (enhancement or suppression) as well as the magnitude of the effect is dependent of a number of factors such as the nature and duration (acute vs chronic) of the psychological stimulus. In addition individually determined factors related to personality type, perception of the event and coping style play a significant role in the stress-induced immunomodulation.

The effects of stress on the immune system have been investigated in animal models as well as in humans. Most paradigms connected with chronic stress include real life stressor such as social rank in animal colonies, and bereavement, academic exams, marital problems, job strain and unemployment in human society (for references see Bergsma's Introduction). Acute and short lasting stressful situations are mostly studied under controlled conditions, using experimental stress models e.g. mental task, speech task or reaction-time task.

Interestingly enough, relative little attention has been given to the effect of a possible interaction between chronic stress as perceived by a given individual, and his or her response to an acute (experimental) stressor. In our group we have been interested in the identification of individual differences in immunological changes induced by a laboratory stressor, and factors that relate to these differences. It was hypothesized that persons experiencing accumulated (chronic) stress in daily life will react differently to an acute stressor from individuals reporting low stress levels. In recent studies this assumption could be validated; using a shortlasting inter-