SESSION 11 ELECTROENCEPHALOGRAPHY

11–3 Use of Skin Resistance in Monitoring Sleep and Wakefulness

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One of the oldest and most widely used aspects of medical treatment is to ensure that the patient gets adequate rest and, in particular, sound sleep. As patient care in hospital becomes more complex and sophisticated, this aspect tends to be overlooked or considered unimportant. Patients' subjective reports of their own sleep may be seriously in error under those circumstances when it is most needed, during acute illness in hospital. In the past most methods for monitoring sleep and wakefulness have depended on the electroencephalogram which is relatively difficult and expensive to record and interpret. We have developed a simple but accurate method for monitoring continuously the sleep and wakefulness of patients in hospital wards. This method is based on the measurement of electrical resistance of skin on the palmar surfaces of 2 fingers.

METHOD: The apparent electrical resistance of palmar skin is proportional to the potential developed between non-polarizing electrodes (silver-silver chloride) on the skin surface when a constant direct current (5μA) is passed between them. This resistance is due mostly to the electrical properties of the semi-permeable membranes of the sweat glands and epidermis, and fluctuates as a result of the activity of sympathetic, cholinergic nerve fibres supplying the sweat glands.

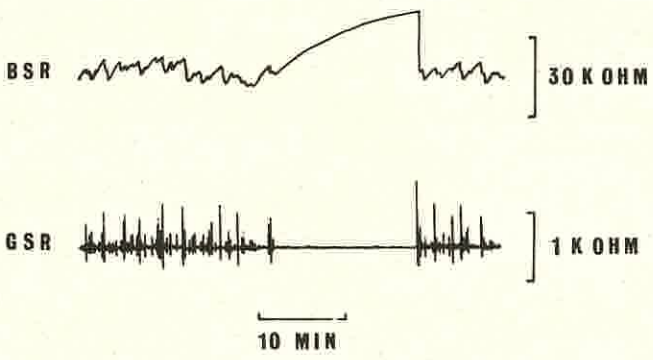

Fig. 1. The pattern of basal skin resistance (BSR) and galvanic skin responses (GSR) during wakefulness and a 15 minute period of sleep.

During wakefulness there are small fluctuations in skin resistance of a few seconds duration, called galvanic skin responses (GSR). These occur spontaneously and in response to any novel or alerting stimulus. The general level of skin resistance about which these GSRs occur, called the basal skin resistance (BSR), also changes slowly over periods of minutes to hours. We have developed a system using integrated circuitry for direct recording of the BSR at low gain as well as an AC-coupled recording of GSRs at higher gain. (Fig. 1)

With sleep onset BSR rises in a smooth curve and GSRs cease but may reappear in bursts during sleep. The pattern of changes in the 2 channels of information recorded at slow chart speeds (e.g. 15 cm/hr) enables the duration of sleep through the day and night to be measured with an accuracy of a few minutes. Even brief arousals from sleep cause a dramatic and quite characteristic decrease in BSR.

APPLICATIONS: The delay before sleep onset at night, the number and duration of night awakenings and the duration of sleep have been measured in patients in hospital wards before and after surgical operations. These measurements have indicated degrees of sleep disturbance which have varied from negligible to severe in different patients and under different circumstances in hospital.

DISCUSSION: Continuous recordings can be made throughout the day and night with very little inconvenience to the patient. Electrodes attached to the fingertips must be reapplied every 12 to 24 hours. The main disadvantage of the method is that the various stages of sleep and dreaming, defined on the basis of the electroencephalogram and electrooculogram cannot be distinguished reliably. Nevertheless, it provides a simple and accurate measure of several important parameters of sleep and sleep disturbance.