130. Allen, Robert Day, "Il Microtubulo Come Motore Intracellulare", in *Le Scienze Quaderni: L'Organizzazione della Cellula*, (a cura di Vera Bianchi e Lucia Celotti), N.50, Ottobre, 1989, pp. 42 - 50.
131 Liss, Jerome, "Filosofia della Scienza e la Ricerca Clinica," op. cit.
132. Venturini, Ricardo, *Sistema Neurovegetativo e Personalita*, Roma, Bulzoni Ed., 1979.

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THE DIAPHRAGM - BETWEEN BODY AND EMOTIONS

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The diaphragm is one of the main organs for carrying out the function of respiration and circulation. It is linked with our emotional life in a way that is often overlooked in medicine (1). Certain emotional states allow the diaphragm to function freely; others inhibit it. Submaximal stress that continues over a long period, however, may be just as inhibiting as achronic emotional tension (2). In context of psychosomatic disease, it is important to consider what happens when the function of the diaphragm is inhibited.

It is primarily the spontaneous, autonomic respiratory function that suffers in such cases, and the person's ability to take deep breaths voluntariy may be unaffected. Thus the tension in the diaphragm is not easy to register when the person is asked to breathe deeply. In serious cases, X-rays may show a flattened or domed diaphragm with a small range of movement (3).

THE FUNCTION OF THE DIAPHRAGM AND THE ORGANS ABOVE IT

The heart rests on the diaphragm. In younger people a definite synchronization has been demonstrated between the movement of the diaphragm and the heart contractions.

One of the clinical signs of tension is active expiration at rest, and such breathing is not unusual for people with reduced diaphragm function and thoraxes in the inspiration position. They thus lose the possibility of recreation inherent in the resting phase of the respiratory cycle. Active expiration causes the pressure in the lungs to rise. The equal pressure point is moved to a more central position and the closing capacity (5) becomes higher. The lower part of the bellows functions less well, the release of air from the lungs is impaired, and mucus often remains in the deeper-lying regions. This increases the risk of atelectasis, inflammation of the lung, and other lung complications.

THE DIAPHRAGM AND THE ORGANS BELOW IT

The presssure in the abdominal cavity decreases in the expiratory phase and increases in the inspiratory phase, but the variations in pressure are not as great as in the thoracic cavity. The changes in pressure enhance peristalsis and other abdominal functions. Strong physical exertion may cause stasis in the liver, which is experienced as a stitch in the right side. This can be helped by deep breathing, which increases the pumping action of the diaphragm. General pains in the region of the liver with no "pathological" cause may also be helped by improving the spontaneous functioning of the diaphragm. The abdominal action of the bellows also contributes to the functioning of the colon. In patients who have been operated on in the region of the diaphragm, the basal bellows movement is often impaired or halted, and in addition to inhibited lung function, such patients often have difficulty in expelling gases and in defecation. In order to prevent or

alleviate these complications, special care should be taken to maintain the proper functioning of the diaphragm.

DIAPHRAGM FUNCTION AND DISORDERS OF THE PELVIS AND GENITAL ORGANS

The pelvic floor is often referred to as the *lower diaphragm*. There is a synergistic interaction between these two muscles: when the diaphragm moves downwards, the pressure in the abdominal cavity increases, and this slightly depresses the lower diaphragm. The opposite occurs when the diaphragm moves upwards. When the diaphragm is not functioning properly, both circulation and function are impeded in the pelvic floor, and this affects not only the functioning of the organs there, but also body awareness and perception in the genital area.

This applies among other things to sexual functioning in so-called healthy people, and is associated with sexual difficulties and disorders of the urogenital system, such as menstruation problems, haemorrhoids, recurring cystitis.

When the diaphragm has a restricted range of movement, the epigastric muscles and those around the costal arch (which have a high degree of stiffness) are often hard, and sometimes this condition is found together with a slack pelvic floor and/or slack stomach muscles (which have a low degree of stiffness). Both tense and slack pelvic floor muscles inhibit the circulation in the genital area, and can lead to leakage of urine and related disorders.

DIAPHRAGM FUNCTION AND THE PERIPHERAL CIRCULATION

Together with the pumping function of the heart, the diaphragm helps to maintain the circulation in the arms and legs. When the pressure rises in the abdominal cavity, this promotes the flow of blood to the extremities, and the opposite occurs when the pressure decreases during the expiratory phase (6). In this way the action of the diaphragm affects the circulation in the arterial, venous and lymphatic circulations. This has a number of consequences. Reduced diaphragm function after an operation, for example, can slow down the circulation and thus increase the risk of thrombosis. After injury, too, the healing process is influenced by the effect of the diaphragm on the circulation.

The bellows function is important for the lymphatic circulation. The lymph vessels have no valves, and the lymphatic circulation is mainly controlled by muscular function and changes in pressure in the thorax and abdomen. Thus there is a close connection between lymph, bellows function and the immune defence.

DIAPHRAGM FUNCTION AND BACK PROBLEMS

As mentioned above, the muscles in the area of the diaphragm often have a high degree of stiffness. The diaphragm itself originates in the area around the 10th to the 12th thoracic vertebrae and so do the quadratus lumborum and the psoas major muscles; furthermore the transversus abdominis muscle is attached here. It is common for all the muscles that have their attachment or origin in this area to have a high degree of stiffness, and the area

over the spine corresponding to this segment is often flattened. An accompanying hypermobility in neighbouring segments is not unusual. A high degree of muscular stiffness (increased muscular tension) increases joint compression and predisposes to degenerative joint disease. This indicates that there is a close relationship between the diaphragm, increased muscular tension and degenerative joint diseases (7). These areas are also subject to recidivating neuropathies, which are often highly resistant to treatment. It is not impossible that pathological conditions like this may be connected with reduced microcirculation in small nerves near the spine (8).

With "bad backs" it used to be thought that training the abdominal muscles would increase the intra-abdominal pressure and thus help to protect the back when lifting, etc. However, Hamborg et al (9) have shown that the intra-abdominal pressure is not influenced by training the stomach muscles, which indicates that the factors controlling this pressure are extremely complex.

DIAPHRAGM FUNCTION AND PROBLEMS OF THE HIP JOINT

A tense diaphragm and a continually held-in stomach increase the tension in the pelvic floor. The same effect is obtained by a posture characterized by flexion and adduction (10). The pelvic muscles and the deep muscles of the hip joint lie very close to one another, and in clinical practice a high degree of muscular stiffness is often found in both pelvic and hip joint muscles. The tension causes greater compression in the hip joint and reduces the circulation to the joint cartilage. This increases the risk of developing musculoskeletal/connective tissue diseases.

DIAPHRAGM FUNCTION AND SHOULDER, NECK AND JAW PROBLEMS

When the function of the diaphragm is reduced, the auxiliary respiratory muscles are brought into play, the most important being the sternocleidomastoid and scalene muscles, although the hyoid and other muscles may also be involved. When too much strain is placed on the sternocleidomastoid and scalene muscles they become shortened and hardened, and this may easily give rise to pressure on sensitive structures in the upper part of the thorax. This creates one of the thoracic outlet syndromes, of which the most common are the anterior scalene syndrome, the pectoralis minor syndrome and the hyperabduction syndrome.

When the hyoid muscles are brought into play to help breathing, they may become hardened and shortened, and quite often interfere with swallowing. In order to create more room in the throat the person often has to stretch the neck forward when swallowing. The short extensors at the back of the neck may then begin to act as a point of fixation for the auxiliary respiratory muscles, so that the clavicula and the first rib can be raised and the thorax expanded upwards. When the infrahyoid and suprahyoid muscles are overloaded and shortened, they pull the jaw downwards, and the resulting position of the jaw at rest is with open mouth. This can be seen in children with habitually open mouths (11). Since habitual gaping is socially unacceptable, such people usually try to keep their mouths shut, which requires increased tension at rest in the masseter and temporalis muscles. This

interaction between the neck and the jaw increases joint compression, thereby laying the foundations for reduced circulation and degenerative disease in the joints of the jaw and cervical vertebrae.

Muscular tension in the neck and throat can also irritate the navus nerve and increase irritation and symptoms in the organs innervated by this nerve (8).

BODY EQUILIBRIUM AND DIAPHRAGM FUNCTION

The relations between the body axes and the position of the centre of gravity affect diaphragm function. In other words, posture influences the function of the bellows. Here there are a large number of possible variations. In kyphotic people, for example, the movement of the bellows takes place mainly in the kyphos. The upperpart of the back moves, but the ventero-basal parts of the thorax remain almost immobile.

The body's centre of gravity should be over the midline between the feet. A person who does not stand squarely on his feet will tend to tense his mucles upwards in order to keep his balance. If such a person tenses the muscles in the hips and bellows, free and spontaneous breathing is inhibited. This shows how there can be a close correlation between breathing and the way a person stands. In the same way the posture of hunched shoulders and a forward tilt of the head disturbs the equilibrium of the body and also inhibits free, spontaneous breathing.

The above discussion shows how important the pumping action of the diaphragm is for most of our body functions. A greater interest in breathing and diaphragm function would have beneficial results for both prophylaxis and treatment.

REFERENCES

1. Thornquist, E. Bunkan, B. — *Ha er psykomotorisk behandling* (What is psychomotor treatmen). Universitetsforlaget, Oslo, 1986.
2. Monsen, K. — Psykosomatisk fysioterapi (Psychosomatic physiotherapy). Psyk-Nio, Fagskrift for Nic Waal's Institutt, Oslo.
3. Lange Nielson, F. — Demonstrasjon (Demonstration). Department of Lung Diseases, The National Hospital, Rikshospitalet, Oslo, 1965.
4. Bunkan, B. — Risiko for hjerte- og kardiacsykdommer hos menn i Oslo. Oslo-undersokelsen (Risk of cardiovasculardisease among men in Oslo. Oslo Study). Thesis for magister degree, Department of Psychology, University of Oslo, 1977.
5. Ingvers, U. Andersson, J.B. — *Rasjonell lungefysioterapi* (Rational lung physiotherapy).Munksgaard, Copenhagen, 1983.
6. Tvedt, B. — Lecture addressed to teachers at the Colege of Physiotherapy, Oslo.
7. Bunkan, B. Thornquist, E. Radoy,L. — *Psykomotorisk behandling. Festskrift til Aadel Bülow Hansen* (Psychomotor treatment. Festschrift for Aadel Bulow -Hansen). Universitetsforlaget, Oslo, 1982
8. Rindvik, E. — Personal communication. Department of Anatomy, University of Oslo, 1987.
9. Hemborg, B Moytiz, U. Hamberg, J. Lowing, H. Akesson, T. — At lyfta - en fraga p, teknik. Lifting- a question of technique Bygghalsans Forskningsstiftelse. Internal project No.4 Stockholm 1983:7
10. Bunkan, B. — *Muskelspenninger og kroppsbilde* (Muscular tension and body image). Universitetsforlaget, Oslo, 1988.
11. Braatoy, T. — *De nervose sinn* (The nervous temperaments), Cappelen, Oslo, 1947.
12. Dahl, H. Olsen, R.B. Rinvik, E. — *Menneskets anatomi* (Human anatomy). Cappelen, Oslo, 1981.