REHABILITATION MEDICINE—Adding Life to Years

Use It or Lose It—The Hazards of Bed Rest and Inactivity

PAUL J. CORCORAN, MD, *Boston, Massachusetts*

Professional experience and lay wisdom teach us the benefits of exercise and the hazards of idleness. Yet the myth persists that "bed rest is good for you" when ill or convalescing. Abundant scientific evidence in the past 50 years has demonstrated the specific damage done to each of the body's organ systems by inactivity. Both aging and inactivity lead to strikingly similar kinds of deterioration. I summarize the data from military and veterans' hospitals, rehabilitation experience, aerospace research, and gerontology and review the physiologic and metabolic changes of aging and inactivity, along with strategies to help prevent the iatrogenic complications of bed rest.

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Look at a patient lying in bed.
What a pathetic picture he makes.
The blood clotting in his veins,
the lime draining from his bones,
the scybala stacking up in his colon,
the flesh rotting from his sweat,
the urine leaking from his distended bladder,
and the spirit evaporating from his soul.

RICHARD ASHER, MD[1]

Most people take for granted the assumption that rest is beneficial in restoring the health of an ill or injured person. The bed is the central focus of hospitals and the standard unit of size for health care facilities. On admission, patients are shown to their beds, their clothing is taken away, and skimpy gowns are provided. Hospital procedures and expectations sharply curtail mobility. Even ambulatory patients generally remain under the sheets, if only for warmth and modesty.

Before the 1940s, strict bed rest was the rule for two weeks after childbirth, three weeks after herniorrhaphy, and four weeks or more after myocardial infarction. The shortages of hospital beds and personnel during World War II led to the surprise discovery that early mobilization of the sick and injured actually improved results and lessened complications. Postwar rehabilitation programs in the Veterans Administration hospitals taught that the avoidable complications of bed rest were often more disabling than the original injury. Deitrick and colleagues, in a classic study of immobilized healthy young men and seriously ill polio patients, documented striking metabolic and neuromuscular deterioration.[2] More recent research by the National Aeronautics and Space Administration (NASA) produced additional evidence for the damaging effects of prolonged inactivity and weightlessness.[3] In the 1980s, the extremely early hospital discharges caused by the diagnosis-related group system of prospective payment have pushed early ambulation to the limit, causing considerable inconvenience and discomfort but little documented evidence of harm.

Short-term benefits may result from limited rest of individual body parts: elevating the legs to treat shock, eliminating gravity in peripheral edema, relieving abdominal wall pressure after laparotomy, or resting traumatized soft tissues or skeletal structures. The severity of an illness may leave no choice except bed rest, but the rest itself is rarely beneficial. On the contrary, virtually every organ and body system promptly and progressively deteriorates when inactivated (Table 1).[4]

Effect of Rest on Body Systems

Joints and Connective Tissues

The moving parts of the body—joints, ligaments, tendons, muscle, and skin—all have a normal range of motion that is necessary for the proper performance of physical tasks. Any decrease in the normal range of motion is designated a *contracture.* Contractures may be anticipated side effects of necessary treatment, such as a knee contracture after plaster immobilization. More often, contractures are produced unwittingly and unnecessarily—the frozen shoulder caused by the use of a sling to treat a Colles' fracture of the wrist, for example.

Contractures probably begin forming within eight hours, as illustrated by the morning stiffness after a night's sleep, but this can be reversed by a single range-of-motion exercise,

TABLE 1.—*Unnecessary Additional Disabilities Due to Bed Rest*

Joints	Contractures: loss of normal range of motion
Muscles	Disease atrophy: 15% loss per week of inactivity
Bone	Osteoporosis; pathologic fractures
Urinary tract	Infection; calculosis
Heart	Deconditioning: decreased cardiac reserve; decreased stroke volume; resting and postexercise tachycardia
Circulation	Orthostatic hypotension; thrombophlebitis
Lung	Pulmonary embolism; atelectasis; pneumonia
Gastrointestinal	Anorexia; hospital-acquired malnutrition; constipation, impaction
Skin	Decubitus ulcer
Psyche	Anxiety, depression; disorientation

From the Departments of Rehabilitation Medicine, Tufts University School of Medicine, Boston, and the New England Sinai Hospital and Rehabilitation Center, Stoughton, Massachusetts.

Reprint requests to Paul J. Corcoran, MD, Department of Rehabilitation Medicine, New England Sinai Hospital and Rehabilitation Center, 150 York St, Stoughton, MA 02072.

the pleasurable morning stretch when we first get out of bed. The rate of contracture formation is accelerated by several factors that often may coexist in the immobilized parts: edema, bleeding, infection, burns, or the healing of traumatic or surgical wounds.

Contractures are corrected by therapeutic heating—to increase the compliance or "stretchability" of collagen fibers—followed by range-of-motion exercises. Serial casting or adjustable orthotic devices may be necessary in more severe cases, and surgical correction is occasionally required.

Range-of-motion exercises can be encouraged or done by nursing staff as part of routine care. Proper positioning does not prevent contractures but may cause them to occur at a less undesirable angle. The best prevention is early ambulation, bathroom privileges, and self-care activities that require patients to use and maintain their full range of motion.

Muscles

A muscle is only as strong as it needs to be for the tasks it regularly does. Disuse atrophy leads to the loss of about an eighth of a muscle's strength with each week of total inactivity. A partially used muscle exerting less than 20% of its maximum force will begin to atrophy, whereas regular exertion at 20% to 30% of maximum force will preserve a muscle's strength.

Backache after bed confinement is commonly caused by disuse weakness of paraspinal and abdominal muscles; this, of course, limits the usefulness of bed rest in the treatment of low back pain. Physical therapy may prevent disuse atrophy, but simple out-of-bed orders, bathroom privileges, or bedside commode prescriptions can do much to retard its progression.

Bones

Bone is a dynamic tissue that undergoes continual deposition and replacement, in response to the dual stimuli of weight bearing and muscle pull. After bed confinement, calcium loss from bone begins immediately, and increased urinary clearance of calcium is detectable within a few days. This can lead to urolithiasis and heterotopic calcification. Calcium clearance is four to six times normal within three weeks of total immobilization.[2] More gradual calcium loss accompanies the declining activity of age or chronic illness and accounts for the frequency of hip and vertebral fractures in the elderly.

Urinary Tract

The ureters empty by peristalsis, but the renal pelvis drains entirely by gravity. In a recumbent patient, loss of this gravitational emptying leads to stagnation in the calyces. This predisposes patients to calculus formation and infection. Bladder emptying may also be incomplete when voiding has to be done in a supine position on a bedpan or into a urine bottle. These risks can be lessened by frequent turning, sitting up in a chair, or the use of a bathroom or a bedside commode in preference to the bedpan. Adequate fluid intake and intermittent catheterization of the neurogenic bladder are additional preventive measures.

Heart and Circulatory System

Like other muscles, the heart undergoes disuse atrophy when patients become inactive. Studies done by NASA before the first manned space flight showed that after three weeks of bed rest, stroke volume fell, causing the heart rate to rise by 10 beats per minute.[3] Postexertion heart rates were 40 beats per minute greater than before the bed rest. Exercise tolerance did not return to normal again until after five to ten weeks of vigorous reconditioning.

Peripheral and pelvic venous thrombosis probably occurs to some extent in every bed-bound patient, and pulmonary embolism is the commonest cause of sudden, unexpected death of patients in hospital.[5] Orthostatic hypotension is another result of recumbency or weightlessness. The use of anticoagulants and elastic stockings can prevent or treat these complications, but the best prevention is to limit the duration of bed rest and inactivity.

Lungs

The mucous film lining the smaller air passages tends to pool when patients lie in one position, leading to local atelectasis. Sedation and dehydration accelerate this process. The work of respiration is greater in recumbency than when a person is sitting, and deep breaths and sighs occur less frequently. Atelectasis and pneumonia are well-known complications of bed rest, even in the absence of preexisting pulmonary disease. Pulmonary embolism and aspiration pneumonitis are other complications of bed rest. Preventive measures include frequent turning, maintenance of adequate fluid intake, respiratory therapy for high-risk patients, and early mobilization of bed-bound patients.

Gastrointestinal Tract

Documented effects of bed rest include diminished appetite and fluid intake. Swallowing may be difficult in the reclining position. Peristalsis decreases with inactivity. Constipation and malnutrition are familiar features of debilitated bed-bound patients.

Skin

Capillary filling pressures range from about 18 to 35 mm of mercury, or about 0.5 lb per in^2. Thus, a 150-lb body would need 300 in^2 of skin surface to avoid compressing skin capillaries. Skin circulation is obstructed, and skin perfusion ceases over the bony prominences of a recumbent patient, causing infarction of the skin—bedsores. Air-fluidized beds can prevent this, and alternating pressure air mattresses may help, but turning the patient at least every two hours is the simplest and safest approach. Egg-crate foam mattresses and protective foot cradles provide additional protection, but getting the patient out of bed is the best preventive.

Psyche

At NASA, studies of normal young men who were kept in bed for five weeks showed significant increases in anxiety, hostility, and depression, together with altered sleep patterns.[6] Bed rest appears to be a subtle form of sensory deprivation. Of interest is that exercising during bed rest reduced these deleterious effects considerably.[7]

A longer-term psychological consequence of bed rest is the "learned helplessness" sometimes seen in patients after prolonged hospital stays. Bed-bound patients are expected to play a sick role. The "good" patient is docile and compliant, taking medications and following professional orders without questions. Care providers are likely to reinforce this sick behavior and react negatively to patients who attempt to manipulate or challenge hospital routines. Bed-bound patients

lose control over the most intimate aspects of their lives: external forces control their diets, sleep, money, social contacts, and sexual expression. Medications, appointments, and health records are managed by others. Small wonder that many patients have trouble resuming independent management and decision making after prolonged bed rest.

Other Diseases Associated With Inactivity

Reflex sympathetic dystrophy or "causalgia" after a neurologic injury is much more common if the injured limb, or the entire patient, has been immobilized. The fibrositis-fibromyalgia syndromes are associated with inactivity. The hypochondriac behavior pattern known as "compensitis" leads to many of the physical complications listed above, when financial secondary gain encourages inactivity. Most chronic pain syndromes begin during periods of bed rest or diminished activity and respond therapeutically to increased activity. Depression and inactivity are intimately connected, and physical activity has proven therapeutic value in the treatment of depression.

Aging and Disuse

Bortz and others have called attention to the remarkable similarity between the physiologic effects of aging and the changes found after inactivity.[8] A lifetime of exercise, or a therapeutic exercise program after a period of inactivity, will retard or reverse these changes, even in an aged person.

In the cardiovascular system, both disuse and aging lower the maximum oxygen uptake, cardiac output, and stroke volume and raise the blood pressure due to increased peripheral resistance. Erythropoiesis and red cell mass diminish, protective fibrinolytic activity is reduced, and serum cholesterol and triglyceride levels increase. Both aging and disuse change the body composition and metabolism in similar ways: decreased lean body mass, increased body fat, calcium loss, decreased cortical thickness of bone, decreased glucose tolerance, lowered mean body temperature, and diminished serum androgen levels with decreased spermatogenesis and libido.

There is a substantial decrease in the central nervous system content of the neurotransmitters dopamine, norepinephrine, and serotonin both in aging and after inactivity. Both conditions decrease the dominant frequency of the electroencephalogram and lead to disordered sleep patterns. Auditory thresholds increase, taste sensitivity drops, and intellectual capacity is lowered, with diminished memory and increased depression. The actin and myosin content of the myofibrils decreases both with aging and with disuse, and there is a decrease in the cross-sectional area of muscle fibers, connective tissues, and overall muscle size. The muscle capillary beds shrink considerably both in aging and disuse, leading to the increased peripheral resistance and the elevated blood pressures associated with both states. Frontera and co-workers have shown that these changes can be reversed through exercise, even in the aged.[9]

TABLE 2.—*Strategies for Minimizing Harmful Effects of Bed Rest*

Minimize duration of bed rest
Avoid strict bed rest unless absolutely necessary
Allow bathroom privileges or bedside commode
Stand the patient for 30 to 60 seconds whenever transferring from bed to chair
Encourage the wearing of street clothes
Encourage taking meals at a table (not in bed)
Encourage walking to hospital appointments
Encourage passes out of the hospital on evenings and weekends
Order physical therapy and occupational therapy as needed
Encourage daily range-of-motion exercises as a basic part of good nursing care

Conclusion

In the past 50 years, there has been a complete reversal of the role of bed rest in the health care system. Initial stimuli for these changes have been largely nonmedical—war, manned space flight, or health care cost containment. Serendipity and research have shown that inactivity is harmful and that early ambulation and exercise can prevent many of the complications of both disuse and aging. Regrettably, everyday practices and attitudes have not caught up with scientific knowledge, and bed rest and immobilization are still overused by patients and physicians. The fitness craze is principally a phenomenon of young adults, and most of us still accept the spreading waistlines and sagging capacities of midlife as inevitable results of aging.

Bortz concluded his survey on disuse and aging with the observation that, while physical inactivity is not the cause of the aging process and it is wrong to suggest that exercise might "halt the fall of the grains of sand in the hourglass," nevertheless, the toning influence of physical activity may cause the sand to drain more slowly; and a physically active life may allow us to approach our true biogenetic potential for longevity.[7]

Much can be done in our daily patient care to prevent the complications of inactivity and bed rest (Table 2). Asher composed an appropriate physician's prayer:

Teach us to live that we may dread
unnecessary time in bed.
Get people up and we may save
our patients from an early grave.[1]

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