Gait in Obese Patient

Tirza Z. Tamin
Department of Physical Medicine and Rehabilitation, Dr. Cipto Mangunkusumo General Hospital, Faculty of Medicine, University of Indonesia, Jakarta, Indonesia
tirzaediva.tamin@gmail.com

Keywords: Gait, Obesity

Abstract: Obesity is a known risk factor for several diseases, and also negatively affects physical functioning, especially walking ability and performance. Some walking abnormalities in gait could be down to foot problems as increased pressure is placed on the tendons and muscles of the foot, in particular, the plantar fasciitis. It is widely known that overpronation is a very common occurrence in the obese. Understanding mechanisms that may affect the ability to walk in older individuals may help to identify the target for prevention and rehabilitation.

1 INTRODUCTION

Obesity is a known risk factor for several diseases, and also negatively affects physical functioning, especially walking ability and performance. Studies have shown that walking ability is an important prerequisite for autonomy in activities of daily living (Seung-uk et al, 2011). Understanding mechanisms that may affect the ability to walk in older individuals may help to identify the target for prevention and rehabilitation. Interestingly, obesity is one of the main risk factors for knee and hip OA and recent data have shown that obesity is cross-sectionally associated with low walking speed and predicts the development of mobility disability (International Diabetes Institute, 2000).

2 DISCUSSION

2.1 Obesity

The prevalence of Obesity in Indonesia according to Riskesdas 2018 increases when compared to 2013, male 15% to 20% and women 26% to 35% (Kadouh, 2016). Department of Medical Rehabilitation of RSCM increase in the number of patient visits to

The Obesity Polyclinic from 2015-2016 (from 1174 to 2272) and 2017-2018 (from 2821to 3370). The high prevalence increases the morbidity and disability caused by obesity (Winter, 1989).

Obesity can be diagnosed by 2 easily methods, body mass index and waist size. Body Mass Index (BMI) is calculated by dividing body weight in kilograms by height in square meters. BMI correlates with the amount of body fat to the risk of disease. World Health Organisation (WHO) says that central obesity in Asian people can be count from their waist size > 90 cm for men and > 80 cm for women.

2.2 Gait

Normal Gait

Gait means the way a person walks. Abnormal gait or gait abnormality occurs when the body systems that control the way a person is unable to walk in the usual way. There are 2 concepts of normal gait:

- Stride length: the distance between points of contact of the same foot (also one gait cycle).
- Step length: the distance between points of contact of opposite feet (normal is 15-20 in)

Gait cycle has two phases:

- Stance phase: time in which limb is in contact with the ground (60% of the gait cycle)
- Swing phase: time in which limb is in the air (40 % of the gait cycle).

Tamin, T.
Gait in Obese Patient.
DOI: 10.5220/0009062300580061
In *Proceedings of the 11th National Congress and the 18th Annual Scientific Meeting of Indonesian Physical Medicine and Rehabilitation Association (KONAS XI and PIT XVIII PERDOSRI 2019)*, pages 58-61
ISBN: 978-989-758-409-1

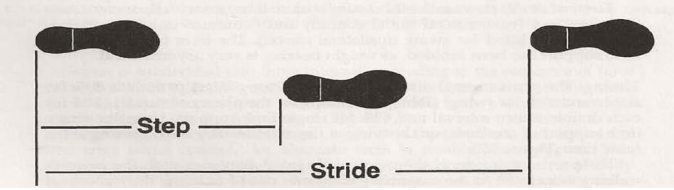

Figure 1: Normal Gait (Kadouh et al, 2016)

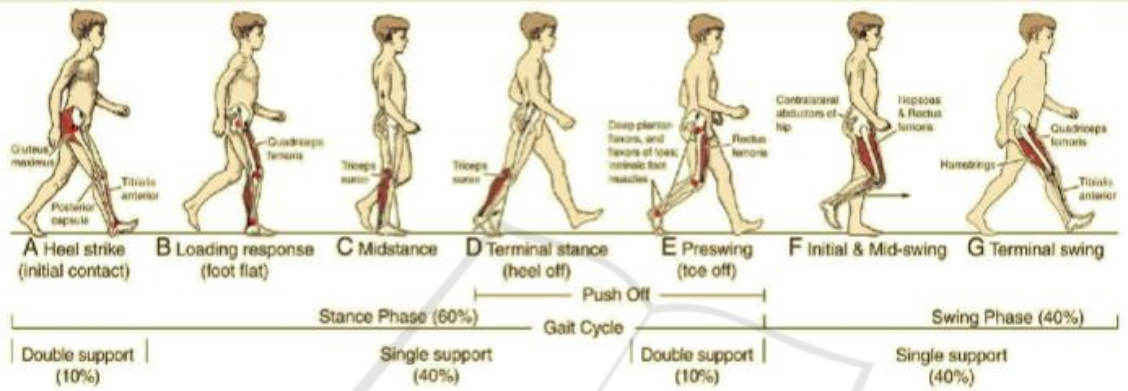

Figure **2:** Types of Gait Cycle

Gait has its determinants that consist of how anybody walks properly, there are

- Pelvic rotation
- Pelvic tilt
- Knee flexion in stance phase
- Foot mechanics
- Knee mechanics
- Lateral displacement of the pelvis

These factors help minimize the excursion of COG to maximize forward progression with the least expenditure of energy.

Abnormal gait

There are many causes of abnormal gait such as focal weakness (example: dorsiflexion weakness), joint contractures (example: tight heel cord), pain (example: hip osteoarthritis), neurological conditions (examples: stroke, Parkinson disease, CP). Abnormal gait is categorized as one of five types based on the symptoms or appearance of an individual's walk. They are:

1. spastic gait
2. scissors gait
3. steppage gait
4. waddling gait
5. propulsive gait

Spastic gait

Spastic gait occurs when a person drags his or her feet while walking. This type can also make someone appear to be very stiff when walking.

Scissors gait

A person whose legs bend inward will often have a scissors gait. With this type, a person's legs cross and may hit each other while walking. The crisscross motion may resemble scissors opening and closing.

Steppage gait

Steppage gait occurs when a person's toes point towards the ground while walking. Often, the toes will scrape against the ground as the person steps forward.

Waddling gait

As the name suggests, a person with a waddling gait moves from side to side when walking. Waddling involves taking short steps as well as swinging the body.

Propulsive gait

Propulsive gait is when a person walks with his or her head and neck pushed forward. It can appear as though the person is rigidly holding a slouched position.

In addition to these five types, a person with a limp is also considered to have an abnormal gait. Similarly, to other abnormalities, a limp may be either temporary or permanent. A limp may also clear up without medical intervention (Ferreira et al, 2013).

Measurement

There are about six quantitative measurements to know is there any gait problems in an obese patient.

Direct Method

Normal gait movement, rotation, and procedures can up to 5 times bodyweight at the ankles and 3 times at the knees (shear force). It's using intraarticular pressure equipment → is rarely used in humans. In animal models can causes excessive dynamic load-cartilage destruction and progressive.

Kinematic Analysis

Obtain hip, knee, and pelvic angles to move the reflection mark on the joint with 4-6 cameras to trajectory on the walking track. It is using the internal axis and rotation angle to describes the 3D movement of the joint during walking and includes pelvic tilt and rotation angle, hip flexion, abduction and adduction angles; knee flexion and abduction angle; dorsiflexion of the ankle and angle of flexion of the big toe; and scope of joint motion of the toe. Weaknesses are complex and time-consuming and difficult to use in clinical use.

EMG Dynamic

Effective for detecting muscle activity during walking to analyzing and recording the time and intensity of muscle activity. Superficial muscles use surface electrodes, muscles in implanted wire electrodes. It is important for a gait that is abnormal with causes on nerves, and muscles. Weaknesses can make the costs required are quite high and difficult to accept widely.

Oxygen Consumption

Analyze energy consumption when walking to using a portable oxygen analyzer. Gas released during the walk to oxygen consumption analysis related to mileage: the lower the oxygen cost to the lower the energy consumption for walking. Detecting oxygen consumption during walking with prostheses, orthosis to the assessment of rehabilitation efficiency.

Temporal-spatial Analysis

Temporal-spatial gait measurement with footprint method (manual ink) pul computerized (platform). Limitations do not record body and arm movements. In the form of an electronic walk pad inserted with baroreceptors to recording real-time walking variables to measuring time-space variables (single foot/feet support time, swing time and pace). Use the comparison before treatment, determine pathological pathology and see the effects of therapy Its use is not much too expensive equipment prices.

Footprint

Implementation using the sole covered in ink and runs through 4-6 m of cloth or white paper. Some literature trajectories up to 10 m, with a starting point of at least three steps before reaching the platform to ensure a steady-state walking pattern. The results were considered satisfactory for both legs full contact with each white paper platform (Ferreira, 2013).

3 CONCLUSION

Abnormalities in gait could be down to foot problems as increased pressure is placed on the tendons and muscles of the foot, in particular, the plantar fasciitis. It is widely known that overpronation is a very common occurrence in the obese. In the study of walking pattern in obesity with osteoarthritis knee has a result that obesity can make changes in walking pattern, the step length is become shorter and also minimize loading of the knee joint. Increased BMI also has a major

spatiotemporal modification, so it comes to shorter step length, lower number of steps and lower walking speed.

Loading in the musculoskeletal system of obese patients can make a change in pathological walking patterns, loss of mobility, and progression becoming knee disability in osteoarthritis. Bodyweight also can increase the joint load. Obese patients have an increased external knee adduction movement (EKAM) compared to patients with normal body weight coupled with systemic factors from adipose tissue and accelerate knee cartilage degeneration in obese patients.

Quadriceps muscle weakness makes rapid deceleration before heel strike and reduces high joint loading adaptation to a walking pattern, so it decreases ground reaction force and decreases walking speed (Ferreira, 2013).

Bwop et al say in 55 obese patients with knee osteoarthritis (OA), who run slower and have a shorter stride length and higher EKAM than normoweight with OA knee. So, the weight has a role in EKAM. Changing the gait pattern can reduce walking speed and decreases EKAM and smaller foot length can reduce peak loading in the knee joint.

Harding et al. say that the relationship between BMI with changes in walking patterns can make changes in biomechanical patterns, so it decreased walking speed and step length in obese subjects with moderate knee OA compared to non-obese with moderate OA (Butler, 2007).

Older adults with obesity show spatiotemporal gait patterns which may help to reduce contact impacts. Also, in obese persons, mechanical energy usages tend to be lower in the anterior-posterior plane and higher in the medial-lateral plane. Since forward progression forces are mainly implicated in normal walking, this pattern found in obese participants is suggestive of lower energetic efficiency (Stein, 2007).

REFERENCES

Seung-uk Ko, Sari Stenholm, and Luigi Ferrucci. Characteristic Gait Patterns in Older Adults with Obesity - Results from the Baltimore Longitudinal Study of Aging. NIH-PA, 2011

International Diabetes Institute/ Western Pacific World Health Organization/ International, Force A for the study of OIOT. The Asia-Pacific perspective: redefining obesity and its treatment. Geneva, Switzerland: World Health Organization. 2000. p. 56.

Kadouh HC, Acosta A. Current paradigms in the etiology of obesity. Tech Gastrointest Endosc [Internet]. 2017;19(1):2–11. Available from: http://dx.doi.org/10.1016/j.tgie.2016.12.001

Ferreira LAB, Neto HP, Grecco LAC, Christovao TCL, Cuarte NAC, Lazzari RD, Galli M, Oliveira CS. Effect of Ankle-foot Orthosis on Gait Velocity and Cadence of Stroke Patients: A Systematic Review. J. Phys Ther Sci. 2013 Nov; 25(11): 1503–8.

Butler PB, Farmer SE, Stewart C, et al. The effect of fixed ankle-foot orthoses in children with cerebral palsy. Disability & Rehabilitation. Assist Technol. 2007;2(1):51–58. DOI:10.1080/17483100 600662009.

Stein RB. Historical Overview of FES. Presented at 2007 Annual Meeting of the American Academy of Orthotists & Prosthetists, San Francisco, CA.