BONE MINERAL DENSITOMETRY AS SUGGESTED INITIAL TEST FOR SPINA BIFIDA PATIENT TO PREVENT MINIMAL TRAUMA FRACTURE: A LITERATURE REVIEW AND CASE REPORT

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ABSTRACT

Bone fracture occurs when a force exerted against a bone is stronger than the bone can bear. This leads to pain, loss of function and sometimes bleeding and injury around the site. Spina bifida is a condition that affects the spine and is usually apparent at birth. It is a type of neural tube defect. This young spina bifida patient present with bone fracture. The patient does not have sufficient information and evaluation related to prevent spina bifida complications. A 24 years old spina bifida patient came to emergency department feeling pain at right shoulder and upper right arm since a week before admission. He had history of lifting his nephew and moving a water gallon. Swelling was revealed on the medial and lateral sides of the right upper arm, minimal deformity with hematoma, and no open wound. X-ray of the right shoulder showed fracture of the right humeral neck. Then the surgeon performed close reduction without internal fixation and immobilized the humeral. The result obtained from this procedure was satisfying and the arm could function properly. The common cause of bone fracture are trauma, osteoporosis, and overuse. Minimal trauma fracture is fracture that occur following little or no trauma and related to osteoporosis. Patients with spina bifida are at increased risk for fractures and low bone mass density. Bone mineral density have an important role in the evaluation of individuals at risk of osteoporosis, and in helping clinicians advise patients about the appropriate use of antifracture treatment. Bone mass densitometry or dual energy x-ray absorptiometry is considered useful and reliable to check bone density. This tool can be suggested as an initial screening test especially in spina bifida patient to prevent future osteoporosis and minimal trauma fracture as undesirable complications.

Keywords: Bone Mineral Densitometry, Minimal Trauma, Spina Bifida, Suggested Initial Test.

INTRODUCTION

Bone fracture occurs when a force exerted against a bone is stronger than the bone can bear. This disturbs the structure and strength of the bone, and leads to pain, loss of function and sometimes bleeding and injury around the site (State Government of Victoria, 2014.). Spina bifida is a condition that affects the spine and is usually apparent at birth. It is a type of neural tube defect (National Center on Birth Defects and Developmental Disabilities, 2020).. This young spina

bifida patient present with bone fracture without history of falling or accident previously.

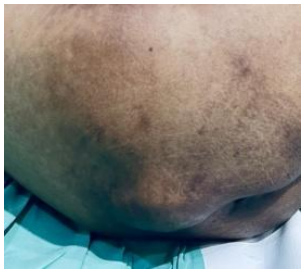

Figure 1. Picture of spina bifida surgery scar (Documented by Victor Kurniawan)

The patient have never had sufficient information about the possible complications that may arise with spina bifida and he never had a useful test to prevent that from happening. In this review, we try to evaluate bone mineral densitometry (BMD) or dual energy x-ray absorptiometry (DXA) as a tool that has role in preventing complications that may be caused by spina bifida.

LITERATURE REVIEW

Spina Bifida is a congenital malformation of the neural tube and accounts for as many as 4.7 cases in 10,000 live births, and it occurs prematurely during the embryonal development, involving different levels of the spine [1]. It results in the defective fusion of posterior spinal bony elements. Subjects with spina bifida have variable degrees of sensory and motor loss, including the skeleton, skin, urogenital system, in addition to those in the central nervous system and peripheral nervous system. Factors that may predispose patients to fracture are the high levels of neurological involvement, the state being non-ambulatory, physical inactivity, hypercalciuria, high levels of body fat, and previous fractures (Martienelli, 2015).

RESEARCH METHDOLOGY

Case Presentation

A 24 years old man with history of spina bifida came to Mardi Rahayu hospital emergency department feeling pain at right shoulder and upper right arm since a week before admission. He denied history of falling or trauma, but he admitted that he had history of lifting his nephew and moving a water gallon, then he felt pain in his right upper arm. Bruises spread to almost of the entire upper right arm. He felt intense pain when the patient moved the right shoulder or try to lift an object.

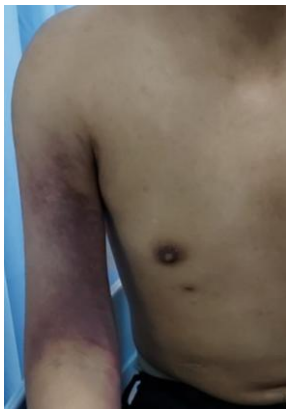

Figure 2. Picture of bruises of the upper right arm patient (Documented by Victor Kurniawan)

Patient had history of ventriculo-peritoneal shunt installment because of the hydrocephalus. Vital signs and general physical examination were within normal limits. The patient's mother admitted that she did not consume folic acid or other pregnancy vitamins during pregnancy. The history of allergies was denied. On physical examination, swelling was revealed on the medial and lateral sides of the right upper arm, minimal deformity with hematoma, and no open wound. There was tenderness and minimal crepitus found in the right shoulder joint, then the distal neurovascular examination was within normal limits (capillary refill time less than 2 seconds), no sensory deficit or paresthesia was found. No other neurological deficit was found. There was range of motion (ROM) decrease in the patient's right shoulder and ROM in other joints within normal limits. In the initial treatment in the ER, analgesics were given to reduce the pain. X-ray of the shoulder joint dextra AP was performed. The x-ray of the right shoulder showed fracture of the right humeral neck with an abnormal position, and dislocation of the right glenohumeral joint.

Figure 3. X-Ray Of The Right Shoulder Taken In Anteroposterior.

Then the surgeon performed close reduction without internal fixation then installed device to immobilize the humeral named U-slab and splinted the right arm. After the procedure, he was able to move

his fingers and did not complain of tingling or numbness. Examination of the distal vascularity of the operative site was within normal limits (capillary refill time < 2 seconds). Patient revisited the orthopedic surgeon after approximately one week after the procedure. When the orthopedic cast was opened, there was no spreading bruise and the swelling was minimal compared to before, and a new orthopedic cast was placed. The result obtained from this procedure was satisfying and the arm could function properly.

Figure 4. Post-operative (Documentary by Victor Kurniawan)

This patient had never done BMD at previous health facility. This spina bifida patient came to our health facility because of his recent symptoms. Literatures says that fractures are often found in patients with history of spina bifida and it might can be prevented by doing BMD test which will be discussed in the following discussion.

RESEARCH RESULT

Table 1. Score Bone Mineral Density

Classification	Bone Mineral Density	T Score
Normal	**Within 1 SD of the mean level for a young adult reference population**	**T score = −1.0 and above**
Low bone mass (Osteopenia)	Between 1 and 2.5 SD below that of the mean level for a young adult reference population	T score between −1.0 and −2.5
Osteoporosis	2.5 or more below that of the mean level of a young adult reference population	T score at or below −2.5
Severe or established osteoporosis	2.5 or more below that of the mean level of a young adult reference population with fractures	T score at or below −2.5 with one or more fractures

Osteoporosis is characterized by susceptibility to fracture; it has substantial health consequences for the individual and society that are potentially avoidable with early diagnosis and treatment. Bone

mineral density (BMD), usually measured at the lumbar spine and hip with dual energy x-ray absorptiometry (DXA), is used to diagnose osteoporosis when the measurement is 2.5 or more standard deviations below peak bone mass (minimum T score, ≤−2.5). Low BMD contributes to elevated fracture risk, but fracture risk is also influenced by age, prior fracture history, and other factors (Leslie WD, Crandall CJ, 2021).

DISCUSSION

The common cause of bone fracture are trauma, osteoporosis, and overuse. Many fractures are very painful and may prevent someone from moving the injured area. Other common symptoms include swelling and tenderness around the injury, bruising, and deformity (Throckmorton TW, 2021). Minimal trauma fracture was defined as a fracture occurring spontaneously or from a fall no greater than standing height (Simonelli C, Ya-Ting C, Morancey J, Lewis AF, Abbott TA., 2003). In 2008, a report entitled Arthritis and Osteoporosis in Australia explained the fracture that occur following little or no trauma, known as 'minimal trauma fractures' (Dixon T, Prescott V, 2008). Minimal trauma fracture or fragility fractures are a sign of underlying osteoporosis. A patient who has sustained one fragility fracture is at high risk of experiencing secondary fractures, especially in the first two years following the initial fracture (International Osteoporosis Foundation, 2022).

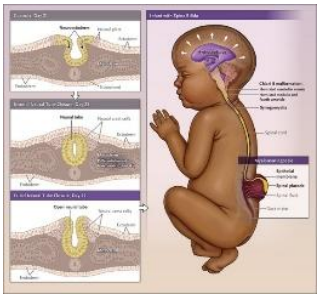

Figure 5. Neural Tube Development And Spina Bifida Birth Defects In Babies.

Spina bifida is a birth defect that occurs when the spine and spinal cord do not form properly. The neural tube is the structure in a developing embryo that eventually becomes the baby's brain, spinal cord and the tissues that enclose them (Mayo Clinic, 2022). The incidence of spina bifida has been estimated at 1-2 cases per 1000 population, with certain populations having a significantly greater incidence based on genetic predilection. Folate fortification of enriched grain products has been mandatory in the United States since 1998; research indicates that folate can reduce the incidence of neural tube defects by about 70% and can also decrease the severity of these defects when they occur.[11,12] A study by Blencowe et al. estimated that in 2015, there were 260,100 birth outcomes worldwide impacted by neural tube defects, with about half ending in elective pregnancy termination (owing to the presence of fetal anomalies) or in stillbirth

(Blencowe H, Kancherla V, Moorthie S, Darlison MW, Modell B, 2018).

Spina bifida is a complex condition that is likely caused by the interaction of multiple genetic and environmental factors. Some of these factors have been identified, but many remain unknown. Changes in dozens of genes in individuals with spina bifida and in those of their mothers may influence the risk of developing this type of neural tube defect. The best-studied of these genes is MTHFR, which provides instructions for making a protein that is involved in processing the vitamin folate (also called vitamin B9). Deficiency of this vitamin is an established risk factor for neural tube defects like spina bifida. Studies have shown that women who take supplements containing folic acid before they get pregnant and very early in their pregnancy are significantly less likely to have a baby with spina bifida or a related neural tube defect (MedlinePlus, 2019).

Spina bifida is accompanied by several orthopaedic disorders of the spine and lower limbs, including fractures of long tubular bones. In spina bifida, osteoporosis plays an important role in the pathogenesis of motor disorders.[7] There was a retrospective study of patients with diagnosis of spina bifida who were followed between 1999 - 2008 and conducted at Dona Estefânia Hospital, Lisbon, Portugal. One hundred and thirteen patients were included in the study. Data in this study indicate a high prevalence of fractures in patients with spina bifida (Marreiros H, Monteiro L, Loff C, Calado E, 2010).

From a journal published in 2012 shows that patients with spina bifida are at increased risk for fractures and low bone mass density. Risk factors that may predispose patients to fractures include higher levels of neurological involvement, non-ambulatory status, physical inactivity, hypercalciuria, higher body fat levels, contractures, and a previous spontaneous fracture (Marreiros H, Loff C, Calado E, 2012).The risk of fracture is lower in adults compared with children with spina bifida (Trinh A, Wong P, Brown J, et al,2017).

Dual energy x ray absorptiometry (DXA) scans to measure bone mineral density (BMD) at the spine and hip have an important role in the evaluation of individuals at risk of osteoporosis, and in helping clinicians advise patients about the appropriate use of antifracture treatment. BMD results can be interpreted using the World Health Organization T-score definition of osteoporosis, a proven ability to predict fracture risk, proven effectiveness at targeting antifracture therapies, and the ability to monitor response to treatment (Blake G, Fogelman I, 2007).

CONCLUSION

Bone mass densitometry or dual energy x-ray absorptiometry is considered useful and reliable to check bone density. This tool can be suggested as an initial screening test in spina bifida patient to prevent future osteoporosis and minimal trauma fracture as undesirable complications.

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