Paraneoplastic Syndrome: A Complication That May Occur From Malignancy

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Abstract

Introduction: This case report describes interventions for a 54 year old woman with paraneoplastic syndrome (PNS). **Examination:** She exhibited impairments such as decreased upper and lower extremity range of motion (ROM), strength, transfer ability, balance, coordination and an inability to ambulate or perform activities of daily living (ADLs). **Intervention:** She was treated with passive ROM to the upper and lower extremities, aerobic exercises such as upper extremity ergometry and NuStep. The major focus of intervention however was core stabilization and transfer training. She used a force biofeedback system (FBS) in conjunction with traditional core stabilization techniques such as bridging and abdominal strengthening exercises to improve her sitting balance. **Outcomes:** The treatment was effective in improving ROM and strength of joints measured. She also had an improvement in assistance needed to transfer from bed to wheelchair and an improvement in her unsupported sitting balance. **Discussion:** The few case reports done on individuals with PNS also found that the techniques performed with this patient were effective treatment methods for improving functional status of patients suffering from PNS. **Conclusion:** The research for PNS is very limited and there is no set protocol on how to treat these individuals. The best treatment approach is to treat the patient's impairments and functional limitations and not the diagnosis.

Key Words: Paraneoplastic Syndrome (PNS), cerebellar degeneration, balance, transfer ability, visual biofeedback, core stabilization, Forced Biofeedback System

Introduction

Cancer is the 2nd leading cause of death in America behind only heart disease. In 2005 it was estimated that 560,000 American died due to cancer. There is no question that it is one of the most debilitating and deadly diagnoses an individual may be given when seeing their doctor. Cancer comes in all types and affects several different systems in the human body. The fight against cancer is well known and the money put into research searching for the cure is in the billions. Some people can beat cancer, Lance Armstrong being a prime example in 2003 when and the rate of survival was about 60%.[1] Remission may occur but it is not always permanent. Of those whose cancer has gone in remission about 66% stay cancer free 5 years later.[1] However most people do not know that if cancer has gone in remission it doesn't mean an individual is going to be able to return back to normal. The presence of a tumor in the body can lead to the development of some severe disorders.

Paraneoplastic syndrome (PNS) is a disorder that can occur while a patient either has cancer or knows that he or she has it or it may develop first before a cancer diagnosis has been determined. It is believe that PNS develops by the body's immune response to the presence of a tumor or substances that are released from the tumor cells present in the body. The body responds by attacking the released substances which in turn can attack normal healthy cells causing damage to healthy tissue. In the brain these immune responses, either T-cells or cancer fighting antibodies can attack healthy brain tissue causing damage to healthy neurological cells.[2]

PNS can be broken down into 4 subcategories such as endocrine, neurological, mucocutaneous, and hematological. Each subcategory has specific diseases related to

that body system which were developed from the presence of tumor in the body. For example if a patient is diagnosed with PNS and is placed in the subcategory of neurological, he or she may have such diseases as lambert-eaton myasthenic syndrome (LEMS), paraneoplastic cerebellar degeneration, encephalomyelitis, limbic encephalitis, brainstem encephalitis, opsoclonus, and polymyositis. Such diseases can form without having to have cancer or PNS but often if diagnosed to have PNS they will likely fall into one of these disease categories.[2]

Neurological PNS disease states are often developed based on which type of cancer he or she may have. For example a person who has developed neurological PNS and is suffering from lung, ovarian, or breast cancer, most likely will have cerebellar degeneration. However those who have small-cell lung cancer are usually diagnosed with LEMS. In each sub-category the patient's signs and symptoms may vary. If someone is diagnosed with neurological PNS it doesn't mean that they are all going to present the same way. The signs and symptoms for neurological PNS vary across a broad spectrum, but some of the common patient presentations are difficulty with speech and swallow, axial and appendicular ataxia, muscle weakness and ocular disturbances such as diploplia and nystagmus. Patients tend to have a decreased coordination, decreased balance and a higher risk for falls.[3,4]

Treatment for PNS usually involves either removal of the tumor that is causing the release of the antigen or antibody or suppression of the immune response to fight the tumor. Both of which are most effective if the pathology is caught early. In some cases the combination of both treatment types is used and it is found that the two together can be more effective than doing one on its own. Physical therapy and rehabilitation are

important to help slow the patient's decline in function. Research has found that individuals not specifically diagnosed with cancer benefit from rehabilitation services because it improves strength, aerobic capacity, coordination, and balance impairments that may have occurred following the treatment for cancer.[5] Patients being treated often require a team like approach where all rehab specialties are used to help assure the best quality of care he or she may need. Speech pathologist help with eating and speech disturbances that an individual may have and occupation and physical therapists work hard on improve function. A combination of strength training, balance training, core stabilization, and gait training are important to assure help a patient minimize their loss in function.[6,7]

Core stability is important to the human body regardless of your age and activity level. Core stability exercises are used to optimize the performance of the elite athlete as well as the elderly individual who recently had a debilitating episode such as a stroke or recent diagnosis of Parkinson's Disease. Core stabilization can be thought of as the stabilization of the muscles attached to and surrounding the spine. Usually these muscles involve the different levels of the abdominals, back musculature, muscles of the upper legs, and muscles in and surrounding the pelvic girdle. All these muscles work together to keep the spine in the most optimal position during motion. Currently the most common diagnosis that patients are treated for in physical therapy is low back pain. Poor lifting techniques and poor core strength have been often linked as the reasons for such a high occurrence of patients complaining of low back pain. Having a strong core is important for individuals to assure that they have good sitting posture and balance. Often times individuals will sit at a desk for long periods of time at work or home and the

posture exhibited is often a flexed posture with a forward head. This position puts added stresses on the spine that in turn can also lead to low back pain and poor sitting balance.[8]

Core stabilization is improved a variety of ways. One way to strengthen the core musculature is to do exercises like crunches and sit-ups which could be categorized as traditional core stabilization. However those exercises tend to target only one muscle group and in order to truly have a strong core all the muscles need to be working and firing effectively. Physical therapists often have patients use a therapy ball to stress the body's core. The purpose of using this piece of equipment is to promote good sitting balance while being seated on an unstable surface. Individuals are required to tighten their abdominals and low back muscles while performing a different series of exercises. Physical therapist will use weighted medicine balls while sitting on the therapy ball to increase difficulty once a patient has progressed from simple exercises. Other things like yoga and pilates focus on core strengthening.[8]

Force Biofeedback System (FBS) by Uni-Cam[9] is a visual biofeedback system that allows individuals to focus on a computer screen and perform certain tasks and make adjustments based on the information being shown on the screen. The system has two force plates that can be used to track percentage of weight distributions of the area where they are placed. They can be placed underneath the feet, hands, or ishical tuberosities. The data that is obtained is able to be stored and/or printed to keep an accurate record of patient progress. The system also has a series of games that individuals can play when they become higher functioning such as downhill skiing where the individual is required to shift weight back and forth between flags on the course.

The purpose of this case report was to examine the effectiveness of the treatments performed on a patient who had PNS. The major focus of treatment was FBS and core stabilization to improve balance and transfers.

Patient Description

Lois is a patient referred to in August 2008 to the clinic for treatment of a fractured right humerus stemming from a fall as well as having PNS. She lives at home with her husband and has a home health aide who comes every week day during the day while her husband is at work. She is a retired teacher. At home she has a rolling walker, a lift chair, a transport wheel chair as well as a maual wheel chair. Her past medical history includes a history of high blood pressure, cancer (fallopian and breast cancer), bone fracture, gastroesophageal reflux disease (GERD) and appendix removal at a young age. She is allergic to both latex and sun block. She was on Kytril, Clonazepam, Toprol, a multi-vitamin, Lexapro, Nexium, and Cardura. Kytril is used to treat nausea and vomiting that is often exhibited by individuals who are or have undergone chemotherapy. Clonazepam and Lexapro are used to help treat depression disorders. Nexium is used to treat GERD and Cardura and Toprol are used to treat and keep blood pressure under control. Lois has received physical therapy in the past at several different facilities for treatment of the humerus fracture and PNS. She is also getting occupational therapy and most recently speech therapy in conjunction with her physical therapy treatment. According to her and her husband her health has steadily declined since February 2007. Since that time she has lost the ability to ambulate and has become dependent on others to perform activities for her. Her strength and endurance has rapidly declined.

Initial Examination

On initial evaluation Lois stated that she did not have any pain and her functional limitations according to herself and her husband was ambulation, transfers, getting dressed, eating, bathing, or any hobbies that she once did. Lois stated that she hasn't walked at all since February 2008 after falling and breaking right humerus. Lois was seated in transport wheelchair with forward head, rounded shoulders, and increased throacic kyphosis with increased posterior pelvic tilt. Patient's speech was slow and slurred. She had adductor tone although tone not rated as which type of tone and on any scale. The evaluation determined that Lois has some disturbances in the cerebellar region of the brain due to decreased coordination and balance. It was determined that she had poor standing and sitting balance both static and dynamic. Lois required moderate assistance as well as use of upper extremities for sitting balance while sitting at the edge of a mat table. Lois has not had the ability to ambulate since her humerus fracture. For patients strength and passive range of motion (ROM) refer to Table 1 and Table 2. Manual muscle grading was measured using the traditional manual muscle testing grading. Grades range from 0/5 to 5/5 where 0/5 is no contractile activity of the muscle and 5/5 is having the ability to hold against maximum resistance.[10,11] ROM was measured by the same therapist to assure good reliability throughout Lois's entire treatment session. The ROM were taken using a goniometer which is the most accurate and effective way to measure ROM.[12]

Lois required moderate assist of 1 to transfer from sit to stand and moderate to max assist to transfer from stand to sit. Patient stand pivot transfers from chair to and

from bed were demonstrated by both aide and husband and were found to be poor and unsafe.

Evaluation

Lois's problem list was determined to be as follows: transfer ability impaired, decreased activities of daily living (ADL's) and independent activities of daily living (IADL's), flexibility/joint mobility impaired, decreased strength, decreased activity level, decreased ROM, decreased sitting balance, and unable to ambulate.

Diagnosis/Prognosis

Lois falls under several Preferred Practice Patterns such as 4G: Impaired Joint Mobility, Muscle Performance, and Range of Motion Associated With Fracture, 5A: Primary Prevention/Risk Reduction for Loss of Balance and Falling, and 5E: Impaired Motor Function and Sensory Integrity Associated with Progressive Disorders of the Central Nervous System. According to her signs and symptoms she would best fit in 5E preferred practice pattern. According to the Guide to Physical Therapy Practice[13] her prognosis is that 80% of the patients who fall within 5E practice pattern will reach expected outcomes and desired goals within 6 to 50 visits but because her diagnosis is so unique and so rare this may be much less. Due to the different ways that patients have exhibit PNS each person's prognosis may be different. It is difficult to give a patient diagnosed with PNS an accurate prognosis because it is difficult to predict the outcomes of each patient's disease process. The best change for a positive prognosis depends on how early on the disease is noticed and how quick treatment has started.

Plan of Care

Since PNS is debilitating the major goal of all the treatments for Lois was to slow the progression of the disease and try to maintain or improve function as much as possible. The plan of care at the initial evaluation is to focus on the patient, aide, and family education of exercise training and transfer training so she is able to get some activity at home. A home exercise program (HEP) for home needs to be developed. She will participate in stretching and strengthening of bilateral shoulder and hip joints as well as strengthening of muscles surrounding elbow, ankle, and knee joints. Other activities will include lumbar and core stabilization for balance training. Lois's goal was to be able to walk again. Short term goals developed were for aide and Lois to be independent with HEP. Another was for her to increase bilateral shoulder flexion to 105 degrees passively while supine. As the patient progressed the goal for the amount of bilateral passive shoulder flexion increased. Long term goals were: aide will be independent in stretching bilateral upper extremities and lower extremities safely to increase functional use. Lois will be able to stand at walker independently to assist with transfers. Lois will be able to stand pivot transfer with walker with contact guard to supervision to decrease the use of aide. Lois will be able to sit at the edge of bed for greater than 30 seconds without upper extremity support. By discharge Lois will be able to propel her wheelchair using her lower extremities 20 feet independently. Lois will be able to transfer to and from supine to sit with supervision to independence. Lois is to be seen twice a week for an hour session each visit. She will continue with therapy until her it is determined she is no longer benefiting from therapy and begins to start to plateau. Lois would benefit from

constant physical therapy for the rest of her life to try and decrease the debilitating effects that the disease can have.

Interventions

The interventions used throughout each treatment sessions varied each day. Initially when Lois started coming to physical therapy the focus was on transfer training and passive ROM of her right humerus. ROM consisted of some grade III mobilizations inferiorly, posterior to anterior, and anterior to posterior. The mobilizations were done to bilateral upper extremities since she had some ROM in both arms. Along with the mobilizations some passive ROM with gentle stretching was also performed in all directions.[14] As she progressed with her treatment the time spent doing the passive ROM and mobilizations decreased and ROM was addressed with a more active assistive to active ROM techniques such as using an upper extremity ergometer. Upper extremity range of motion and stretching started from the beginning of treatment and continued throughout.

Transfer training was performed each day of treatment since it was very important to her and her husband that she improves in this area. Lois, her aide, and her husband were all taught proper body mechanics when transferring, safety, and proper use of a gait belt. She was taught how to log roll onto her left side and push herself up when going from a supine to sit position. All sit to stand and stand pivot transfers were demonstrated before hand and then observed by the husband and aide to ensure they were doing them correctly. Transfer training was an intervention that was focused on throughout her entire treatment.

When Lois first started therapy she was moderate to maximum assist of 1 to go from supine to sit and then back. She was very apprehensive during the transfer and always felt as though she was going to fall. She had to be educated in the proper and easiest way to get up from a supine positing by rolling over to one side then pushing herself up from the side lying position. Lois required maximum assist initially to transfer from sit to stand and on occasion her legs would buckle making the transfer much harder to do alone. A stand pivot transfer for Lois was also a max assist of 1 to pivot from bed or mat to chair or wheelchair and to go back. Initially her aide would be present for treatment sessions allowing for the therapist to educate the patient and the aide in appropriate transfer techniques. Each session that the aide was present the therapist would first demonstrate proper technique and safety for transfers then the aide would have to demonstrate. All transfers were done using a gait belt to assure maximum safety for the patient and the therapist. When the aide would transfer her body mechanics and safety awareness were very poor. She was not very fluid and would do the transfers very hazardously to both herself and to the patient.

Core stabilization and sitting balance exercises were performed since Lois's postural muscles were severally weakened. She needed to have a strong core to assure that she sits appropriately in the wheelchair and doesn't cause any added injury since she does spend a lot of time in the wheelchair. Exercises that Lois had to do to strengthen the core were mat exercises where she was required to tighten her abdominal muscles and do such things as straight leg raises and bridging. This would focus on abdominal strengthening as well as lower extremity strengthening. She also had to unsupported sitting exercises which progressed to unsupported sitting with mild perturbations. She

also had to do exercises where she would sit on a therapy ball with minimal assistance and rock herself back and forth. She would also complete long arc quads and marching while sitting on the ball. Core stabilization exercises were not introduced into treatment until October 2nd, 2008 and they continued to be a focus throughout the rest of her treatment.

A visual biofeedback device was used also to work with her sitting balance. The system is called a Force Biofeedback System (FBS) by Uni-Cam[9] and it uses two force plates connected to a computer where individuals are able to visualize the force being placed on each plate. Lois had the two force plates placed under her ischial tuberosities and asked to hold a seated position for 30 seconds at a time while keeping the weight at a 50:50 ratio on each side. The computer allows her to visualize how much weight she is putting through each force plate and correct it quickly when there is a small shift. The figure demonstrates a example of what the computer screen may look like at a certain ration.

When Lois first started therapy she was unable to sit unsupported without any assistance. She would lose balance and fall towards the side that she had lost her balance. A therapist had to be on either side to assure no injury to her occurred and to help her catch herself. By using the FBS she was able to focus on what she was doing and where her weight was shifting. The visually stimulation of the ratio scale would help trigger a response for her to correct any shifts. When first using the system Lois was only able to hold for about 2 or 3 seconds. The FBS wasn't introduced into her therapy until several 12/19/08 which was about 4 months into her therapy. By February of 2009 Lois was able to sit unsupported using the FBS for upwards of 2 minutes before losing any balance. If

balance was minimally lost she was able to correct and also if she were given small perturbations she could correct without falling.

Lois also did a series of lower extremity and upper extremity strengthening exercises such as supine straight leg raises, bridging, short arc and long arc quads, using her feet to propel her wheelchair which would work her hamstrings. Ankle weights were added to exercises depending on the difficulty for her and if they were appropriate. She also would do the NuStep for about 10 minutes each session which worked on her leg strengthening as well as help increase her aerobic capacity. The strengthening exercises were introduced at the beginning of treatment period and continued throughout her entire stay. However they weren't performed every day due to time limits and if the patient wasn't feeling well that day. Depending on the time she has and how she felt is what determined what strengthening exercises were performed and how many.

Most of her treatment sessions would include some assisted ambulation in the parallel bars going both forward and backwards. Throughout each attempt she would require verbal cues to increase stride length and to stand upright. Lois was very nervous initially when walking since she hadn't done it for some time. When she became nervous her trunk and legs would become unstable and would require stoppage of walking until they were finished shaking. The chart below shows her strength progression throughout various areas of the body. Also Lois gets very nauseous so while standing up on occasion she feels like she may vomit and requires being either set down and on even more intense cases would have to lie down. When Lois first started walked in the parallel bars she could only take about 5 steps with max to moderate assistance from the therapist. About 4 months into her treatment she is able to ambulate in the parallel bars with

moderate to minimal assistance of the therapist however she is able to walk forwards 3 times in the parallel bars as well as walk backwards twice in the parallel bars.

Outcomes

Lois showed great improvement in both her strength and range of motion from her initial evaluation. Tables 3 and 4 shows the improvements she made in her ROM and strength throughout the course of her treatment.

Lois's transfers improved also. She was able to transfer from sit to stand with minimal assistance of 1. Her supine to sit improved to contact guard to supervision of 1. Finally her stand pivot transfer from bed to chair and back improved to minimal assistance of 1. While performing a stand pivoting Lois demonstrated the ability to take small steps to position herself in the appropriate alignment before sitting. Lois showed improvements in unsupported sitting balance. She improved from being unable to sit unsupported to being able to sit unsupported for 2 minutes with visual and verbal cueing with close supervision. She also was able to take minimal perturbations and correct them without any loss of balance

Discussion

Lois was seen in the clinic by mainly one specific clinician with occasional visits being treated by other therapists. Keeping her with mainly one therapist was important because it allowed her to develop a strong and effective relationship with the person treating her. It was also important for documenting progress because measurements remained consistent and accurate based on the person taking them. Lois's treatment sessions were closely monitored and the therapist needed to be available at all times since she does have such difficulty doing most ADL's and IADL's. Each session involved a

wide variety of treatment approaches such as transfer training, balance training, stretching and strengthening, and patient education. The treatments used for Lois were chosen based on the patient's symptoms and what the therapist thought would be the most effective for her treatment. There is no set rehabilitation guideline for PNS as well as very little research done in the area. An article by Perlmutter talks about the treatment approach of an individual with acute diagnoses of PNS with cerbellar degeneration. The researchers used neuromuscular facilitation for postural correction, transfer training, and lower extremity strengthening exercises to try and get the patient back home with the family safely. The results found that with 2 weeks of daily rehabilitation the patient was able to return home with much less of a burden on the family as far as having to do transfer and self-care activities. The individual was still moderate assistance with ADL's and transfers but upon admission to the hospital this individual was dependent for everything. [15,16,17]

Mobilizations and end range stretching were used to help increase ROM in both the upper and lower extremities in certain joints where mobilizations were mainly used on the shoulder. Lois was found to have improvements in all the directions measured. Koval found that the use of conventional therapy such as passive ROM, pain management, and thermal modalities like a moist hot pack are effective treatments in helping individuals who have suffered a minimally displaced humeral fracture without surgical intervention.[18] The patients in the study had developed some shoulder and elbow discomfort resulting from inactivity following the humeral fracture. The patients were followed for more than a year following the start of therapy and found to have significant improvements in ROM and functional status as well as significant decrease in pain.[18]

Unfortunately for Lois she didn't receive intense physical therapy treatment early following the fracture. Lefevre-Colau found that patients who suffer from a proximal humerus fracture benefit and make quicker recovery when they begin early passive range of motion and mobilization of the injured site. The study compared early mobilization of fracture site (3 days post trauma) to those who were immobilized for 3 weeks before undergoing treatment. The author found that not only was early therapy safe and didn't cause harm to the patient but it also lead to quicker recovery in function.[19] Hodgson found that different combinations of therapeutic interventions can be effective in treating individuals who have suffered from proximal humeral head fractures. The author states that electrotherapy and hydrotherapy doesn't have very much research supporting their use but none of the research shows that such interventions can be harmful to the patient. Joint mobilizations have little research regarding their use however the research that has been done has shown positive results in improving ROM as well as decreasing joint pain and swelling.[20]

Since Lois had such poor postural stability the combination of core stabilization exercises on the mat and sitting on the ball were important to help improve trunk strength. In a research article done by Marshall, they found the use of a swiss therapy ball to improve stabilization was effective. They also found that using exercises off the ball such as bridging and abdominal strengthening techniques were effective in improving a patient's core strength.[21] Lois was treated with a combination of the two which proved to be helpful in improving her core stability. The FBS system was used to provide visual stimulation for her awareness regarding her static sitting balance. In a study done using visual feedback to assist in postural stability for patients who have

suffered a stroke the researchers found this method to be effective. Patients would stand on the force plates and observe the screen in front of them. They would be asked to hold the position or move the cursor from side to side. The patient were able to focus on what they were doing while getting that visual stimulation to correct any errors.[22,23] However there is no research involving seated visual biofeedback which is what Lois had underwent for her treatment sessions. Also this study is involving patients that have suffered from a stroke. Although stroke and neurological PNS can have similar symptoms it is hard to tell whether or not specifically if it is a good treatment or not. It seemed however as therapy went on Lois's seated stability was much improved and the time she was able to sit unsupported by looking at the FBS.

Strengths of this case report are that it is a very unique diagnosis. It is very rare to see patients with PNS in the clinic. The case report is great because it adds evidence to what is very limited. It also is uses a combination of core strengthening and the FBS to improve a patients sitting balance. The research currently doesn't have anything regarding the use of the FBS. However a major limiting factor to this study is the very small amount of research there is when it comes to treating this specific type of disorder.

Conclusion

The research for evaluating and treating a patient with PNS is very limited. PNS has several different forms all with different signs and symptoms so it is impossible to say whether or not a specific rehabilitation is better than another. In most cases it is best to treat the patient and their symptoms and not look for a way to treat the disease. Treating individuals with PNS is not like treating patients with anterior cruciate ligament tears or rotator cuff injuries. Those injuries there are set guidelines and treatment

protocols developed based on extensive research. With patients who have PNS it is up to the clinician to look at the research and use sound clinical judgment on what treatment will be the most effective for the patient at that time.

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Table 1: Strength Chart at Initial Examination (8/25/09)

Right	Strength (5/5)	Left
3-/5	Shoulder Flexion	3-/5
4-/5	Hip Flexion	4-/5
4/5	Long Arc Quad (LAQ)	4/5
4/5	Dorsiflexion	4/5

Table 2: ROM Chart at Initial Examination (8/25/08)

Right	Range of Motion	Left
0-95	Shoulder Flexion	0-84
0-50	Hip Flexion	0-55
0-130	Knee Flexion	0-130
0-20	Hip Abduction	0-20

Table 3: ROM Progression

Right				Left		
9/25/2008	**12/9/2008**	**2/19/2009**	**Passive ROM**	**9/25/2008**	**12/9/2008**	**2/19/2009**
0-95	0-120	0-135	Shoulder Flexion	0-90	0-120	0-133
0-100	0-115	0-120	Shoulder Abduction	0-80	0-100	0-100
-2-0	0	0	Knee Extension	0-2	0	0
0-7	0-10	0-10	Ankle Dorsiflexion	0-10	0-10	10

Table 4: Strength Progression

Right				Left		
9/25/2008	**12/9/2008**	**2/19/2009**	**Manual Muscle Testing**	**9/25/2008**	**12/9/2008**	**2/19/2009**
3 / 5	4- / 5	4- / 5	Shoulder Flexion	3 / 5	4- / 5	4- / 5
4 / 5	4 / 5	4 / 5	Hip Flexion	4 / 5	4 / 5	4+ / 5
4+ / 5	4+ / 5	4+ / 5	Knee Extension	4+ / 5	4+ / 5	4+ / 5
4 / 5	4 / 5	4+ / 5	Dorsiflexion	4 / 5	4 / 5	4+ / 5

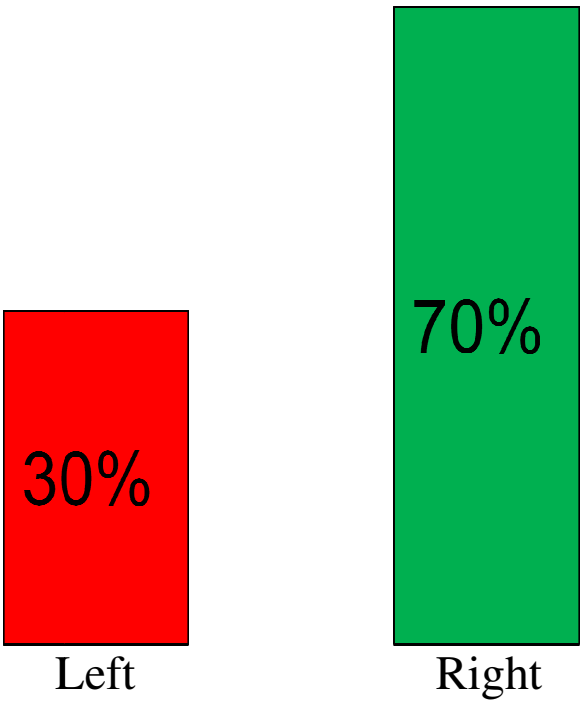

Figure. FBS: Demonstrates ratio of 30% weight on left IT compared to 70% on right IT.