Decreasing Repetitive Motion Injuries in a Blood Center Component Laboratory

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The process of manipulating whole blood into its components is a greatly manual process, unchanged for decades. The idea of splitting blood into its separate components, namely red blood cells, platelets, and plasma (and in some cases, white blood cells) was first introduced in 1940.[1] The process involves placing single bags of whole blood into centrifuge cups specially designed for this purpose, spinning them for a set time at a set speed. The speed and time dictates which components may be made from the donation. The bags are manufactured in such a manner that the main bag, which contains the whole blood donation, is attached via a series of plastic tubing (the tubing is blocked by a breakable cannula, which when broken, allows the fluid to pass through the tubing) to different component-specific satellite bags. The whole blood, while acted upon by centrifugal force, will separate into its separate components based on the density of the cell or specific gravity of the fluid. Because of their heavier mass, red blood cells pack to the bottom of the bag, with some of the larger white blood cells, although some of the smaller white blood cells constitute their own next layer, platelets make the next layer (but will be harvested by performing a second spin), and finally the plasma (the fluid portion of the blood containing the clotting proteins) essentially floats on the top of the cellular components. Based on inventory and patient needs, whole blood donations usually are made in to red blood cells and plasma. What remains in the centrifuge cup following the spin is a flexible bag containing layers of cellular and fluid components, and care must be taken to keep from disrupting the layers of the components while the bag is placed into a spring-loaded apparatus, appropriately named a plasma expressor. The expressor is a manual instrument which has a single vertical base, attached to a spring-loaded hinge at the bottom edge to another opposing movable surface, on which is attached a handle. The technician pulls the handle to open the opposing surface, places the bag inside the open space, and lets the handle go, which exposes the blood layers in the bag to substantial pressure. When the cannula in the tubing is broken, the plasma runs freely into its satellite bag until only about an inch of plasma remains on the red blood cells, at which time the technician uses a hemostat (a medical device resembling a scissor, only without cutting blades, used to pinch tubing) to prevent any more plasma from being extracted, and the pressure is released from the bag, and the tubing is processed for transfusion. As mentioned previously, the process sometimes involves two steps, one “soft spin” (which is obtained by using a slower speed for a shorter time in the centrifuge) whereby the initial product contains red blood cells on the bottom, white blood cells, and then platelet-rich plasma on the top, which is extracted and spun for a second time, or a “hard spin”, which is longer and faster, allowing the platelets to pack to the bottom of the plasma. The remaining product, after expressing the plasma, is a platelet product, suspended in a minimal amount of plasma. Although there are variations in the process from blood center to blood center, the process remains generally the same for all centers, and other procedures involving the manipulation and further manufacture of blood components also involve several manual steps, i.e. leukoreduction, or the filtration of white blood cells from the remaining red blood cells. There are several ergonomic challenges in each of the processes, which will be explored in detail, focusing on three workers' compensation claims involving cumulative trauma disorders (CTDs) filed at a blood center component laboratory in one year's time. This discussion will describe cumulative trauma disorders, and possible programs or options the component laboratory of the blood center might adopt in order to decrease the frequency of workers' compensation claims.

Cumulative Trauma Disorder (CTD) describes the mechanism of injury resulting in a myriad of musculoskeletal conditions depending on the anatomical element involved in the condition. They have several synonyms, such as Repetitive Strain Injury (RSI), Occupational Overuse Syndrome (OSS), and Repetitive Motion Syndrome (RMS). The repetitive actions performed by the associated elements, namely the moving muscles and the bones which support them, if not given ample rest time, result in injury to the tissues, constituting the above synonymous afflictions.[2] They are characterized by discomfort, impairment, disability, or persistent pains in joints, muscles, tendons, or other soft tissues with or without physical manifestations.[3] The Occupational Safety and Health Administration (OSHA) has developed a category used to report work-related injuries and illnesses (known as OSHA 200 events). OSHA 200 injuries are defined as any injury that results from a work accident or from a single instantaneous exposure in the work environment. OSHA 200 illnesses are defined as any abnormal condition or disorder, other than that resulting from occupational injury, caused by exposure to environmental factors associated with employment.[4] If the injury or illness results in lost work time or if the worker requires medical treatment (other than first aid), they are required to be reported to OSHA.[5] In 1997, the total direct health care costs for both reportable OSHA 200 injuries and illnesses for the nation's workforce was more that $418 billion, with estimated indirect costs of $837 billion.[4] Even in 1990 the National Institute for Occupational Health and Safety (NIOSH) reported that 15% to 20% of Americans were at risk for developing CTDs, and it has been estimated that the percentage will increase with time.[6] This increased risk has perpetuated the United States government to take action. In April, 2002, the Secretary of Labor Elaine L. Chao unveiled a program designed to reduce and eventually prevent ergonomic injuries from occurring in the workplace. The program's strategy is divided into industry-specific and task-specific guidelines, support, research, and enforcement.[7] Reducing the total costs from these claims has clearly become a priority both the American society and the business community. It goes without saying that with over 20% of the component laboratory undergoing treatment for cumulative trauma disorders, it is a priority for the blood center as well.

Because of this shift in priority in recent years, occupational orthopaedics is evolving as a specialty among the medical community. This specialty is not unlike sports medicine and occupational medicine in that the injuries and illnesses involving the musculoskeletal system often require not only diagnosis and treatment, but involves several factors affecting the patient outcome. These includes motivational, social, psychological, and economic factors, and community values. In occupational medicine, the total treatment involves not only the patient, but the workplace as well, in order to prevent another injury from occurring. There are several challenges work-related musculoskeletal disorders present to physicians. They often take longer to recover, often requiring several office visits, and sometimes those visits are in the company of the employee's nurse or case manager. The cases often involve an abundance of paperwork, sometimes involving attorneys with expectations for court appearances.[5]

Unfortunately, difficulty exists in differentiating individual risk factors from workplace risk factors. Often times occupational illness involve multiple etiological factors and is not always the job itself that causes the illness.[4] However, there are certain occupations which put all workers in risk categories based on their functions. Especially at risk are computer users, manufacturing and assembly-line workers, data entry workers and programmers, secretarial workers and transcriptionists, painters, musicians, carpenters and construction workers[2] A study involving job-related risks for women concluded that 63% of all work-related repetitive motion injuries occurred in women.[8] Due the component laboratory's assembly-line nature, which is approximately 2/3 female and which also accompanies computer use (each component is logged in a computer system, and various type-written memos regarding the component are also annotated), the workers of the component laboratory are at increased risk for CTDs.

The repetitive nature of work in the component laboratory does not allow sufficient time for the muscles in the hands to rest, which cause the small vessels to constrict as the muscles contract thereby preventing a sufficient amount of oxygen from reaching the muscle cells. Metabolic waste accumulates in the tissues, and the repetitive motion exacerbates the injury, and in some cases inflammation occurs.[2] The three cases explored in this discussion all occurred in women, two of which were diagnosed as tendonitis, and the other was diagnosed as carpal tunnel syndrome. Two of the three women have more than 10 years of component laboratory work experience (the employee with carpal tunnel syndrome has 20 years experience), and the other employee has approximately seven years component laboratory experience.

In the United States, several prevention programs have been designed in response to the increasing demand on prioritizing the prevention of CTDs. One program developed by the Johns Hopkins Hospital and University begins by first performing an ergonomic survey, which is used as an aid in determining whether the claimed injury is indeed work-related. There are two parts to the survey: the medical portion and the workplace portion, both of which are used to determine the scope of the injury and possible intervention opportunities. The medical portion of the survey begins when the employee with the musculoskeletal complaint is evaluated at an occupational injury clinic and a treatment plan is established according to pre-established guidelines, with a referral to a specialty physician for definitive diagnosis. During this evaluation, a careful history of impairment is taken, which includes an investigation of activities which cause and relieve the pain, the quality of the pain, the location of the pain, the scalar severity of the pain, and the duration of the pain. The physical exam is of utmost importance because there are few confirmatory laboratory, imaging, or electrodiagnostic studies that indicate a definitive diagnosis. In this exam casual behavior is also observed, including assessment of movement in the waiting room, ease of dressing and undressing; tasks which are performed by the patient unknowingly being observed. This gives the examiner an idea of mobility without the patient favoring or trying to mask pain, and augments the physical examination. If the diagnosis indeed indicates a work-related musculoskeletal disorder, the employee is asked to complete a repetitive trauma questionnaire, which includes work history, medical history, hobbies, and leisure activities. The second element of the survey involves a survey of the workplace, which is conducted by an industrial hygienist trained in ergonomics. He or she evaluates the workplace of possible workplace hazards. The hygienist focuses especially on any ergonomically-challenging work practices or tools, such as those producing vibration, those intended for use with awkward positioning, repetitive trauma, and so forth. The survey's intent is to determine how the individual employee interacts with his or her environment. When the survey is completed, the results are compiled and the occupational injury clinic makes ergonomic recommendations. Thirty days later the clinic follows up with the employee's supervisor to ensure that the recommendations have been implemented. If the changes have been made and the employee is still experiencing problems, a follow-up survey is conducted by the industrial hygienist.[3]

Automated blood component technology is on the rise. The blood centers of today are promoting automated blood collection (apheresis). Apheresis is the term used to describe the collection of blood products using automated processes. Simplistically, whole blood is collected from the donor, which immediately is transferred to a machine containing a centrifuge. The blood is then centrifuged in order to separate it into its component parts. In a red blood cell apheresis procedure, the red blood cells are retained and the plasma is returned to the donor. Apheresis not only eliminates the need to process the blood components as described previously, but it also enables the phlebotomist to obtain more products per donor (such as two red blood cell products and no plasma, or up to three platelet products), more bang for your buck, as it were.

Another technological advance, which has not yet made its debut in the United States but is already being utilized in Europe, is automated instrumentation for the component laboratory itself, which would process the units without the manual expression requirement.

The component laboratory of the blood center has two options in order to decrease its incidence of cumulative trauma disorders, either the implementation of a program similar to that of Johns Hopkins, or by increasing its use of automated instrumentation. The first, which involves a high-maintenance ergonomic survey, involving industrial hygienists and occupational health physician specialists, while effective, is costly and requires very high maintenance and follow-through. The best option for the blood center involve equipment purchase, training, validation, increased cost, but in the end would decrease ergonomic injury. This is because the ergonomically detrimental expression step, which requires the breaking of a cannula and the use of hemostats, is eliminated.

While we may never completely eliminate the risk of ergonomic injury in the workplace, research and development in the areas of workplace-related CTDs is growing. As we continue to learn about not only the physiological aspects of injuries, but the psychological and economic aspects as well, we will continue to improve this innovative field.

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