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ANATOMICAL AND PATHOPHYSIOLOGICAL PERSPECTIVE ON MARMA IN RELATION TO SHOCK

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ABSTRACT

Sushruta has devoted a significant portion of his work to the surgical aspects of treatment, identifying key areas of the body that need to be safeguarded during any surgical or non-surgical procedure. Additionally, he has detailed a comprehensive guide on these critical areas that should be protected from any harm. These areas are referred to as Marma. It's important to note that not all vital areas lead to death when injured. Some may result in deformity or intense pain. When discussing death by shock, it's crucial to focus on the Marma or lethal spots that can lead to death upon injury.[1,5] Shock is defined as a situation where there is a gradual breakdown of the body's normal functions, often caused by surgery, injury, cuts, poisoning, or infections. Typically, this situation quickly progresses to death. It represents a physiological condition where there's a major decrease in blood flow to the tissues, leading to a reduction in oxygen supply to the tissues. This eventually causes permanent damage to cells and tissues, leading to the failure of major organs, multiple organ failure, and ultimately, death. The reasons for shock can range from low blood volume to damage to the spinal cord. Regardless of the cause, it ultimately results in the failure of the circulatory system, which leads to death.[1] Marma is included in the prognostic analysis of disease. Sushruta defines Marma as the sum total of elements like Mamsa, Sira, Snayu, Asthi and Sandhi. The author gives the etymology of the word "Marma" which also indicates the possibility of death after suffering. The subject of Marma is well explained from the medical and surgical perspective as well as from the prana perspective.[2]

INTRODUCTION

Aacharya Sushruta, widely recognized as the pioneer of surgery, possessed a profound understanding of human anatomy. He not only highlighted the significance of blood but also outlined strategies to stop bleeding. This demonstrates his deep comprehension of the fact that severe bleeding could result in death due to hypovolemia. Additionally, while discussing the complications of injuries from trauma, Aacharya Sushruta noted the symptoms of shock. This evidence underscores his extensive clinical knowledge. As Sushruta devoted a significant portion of his work to surgical treatments, he identified critical areas of the body that needed protection during any surgical or non-surgical procedure. Furthermore, he detailed the importance of these areas, which he referred to as Marma. Not all vital areas are lethal when injured; some may lead to deformity or intense pain. When considering death by shock, it's crucial to focus on the Marma or fatal areas that can result in death from injury.

The amazing and dynamic Ayurvedic therapy known as Marma or Marmavidya has enormous importance in terms of illnesses, longevity, spiritual practice, and health. Marma therapy, also known as marma chikista (Treatment through vital points), is a significant Ayurvedic treatment technique for a wide range of both major and minor health issues. The application of regional anatomy knowledge is more advantageous in the treatment of injuries involving the Marma, or vital parts, of the body, as opposed to an intricate and laborious description of every structure in the body. In addition to possessing an impeccable understanding of anatomy, surgeons must rely on their own expertise and manage critical anatomical structures such as arteries, nerves, joints, tendons, etc.[16]

LITERATURE REVIEW

The phrase Marma is described as *Maryanti iti Marmani*, which translates to locations in the body where injuries can become fatal for the individual. These are specific areas within our bodies where vital functions occur. Therefore, any damage to these areas puts the person's life at risk. This is the reason they are referred to as lethal or essential areas. Marmas are areas where various body parts, such as muscles, veins, ligaments, bones, and joints, come together.[4,5]

The term "Marma," as defined in the Sanskrit dictionary by Sir Monier Williams and Macdonell, refers to vital points within the body, signifying spots that are mortal, vulnerable, or particularly sensitive. The concept also encompasses notions of secrecy and mystery, often associated with areas that may be excessively poignant or painful. Each letter in the word

"Marma" carries a distinct meaning; for instance, "Ma" represents Prana (the breath of life) or Vayu (the air element). Acharya Charaka emphasized that Marma, or vital points of the body, represent crucial areas that house Prana, the essence of life. These points are closely linked to Chetana, or consciousness, which leads to heightened sensitivity to pain in these regions compared to others.[18] Acharya Sushruta defined Marma as specific anatomical locations where various tissues converge, including Mamsa (muscular tissue), Sira (blood vessels), Snayu (nervous tissue), Asthi (bone), and Sandhi (joints).

SHOCK: Shock is one of the major medical emergency having a high mortality rate. It is a condition in which the cardiovascular system fails to perfuse tissue adequately. It is imbalance between supply and demand of body. There may be either increased demand or decreased supply of oxygen in tissues or both. The mortality rate of cardiogenic shock is 60-70%, septic shock is 35 to 40% and in hypovolemic shock varies according to a disease state.

Types of shock: There are four major types of shock viz. hypovolemic shock, cardiogenic shock, distributive shock and obstructive shock. When we consider the shock due to trauma it mostly comes under the hypovolemic shock and neurogenic shock which is a subtype of distributive shock. Hypovolemic shock results due to blood loss and neurogenic shock is consequence of destruction of spinal cord integrity.

Pathophysiology of hypovolemic shock: Hypovolemic shock is the result of either blood loss or loss of extracellular fluid. Traumatic injury is the most common cause of blood loss causing hypovolemic shock. Haemorrhage due to traumatic injury results in depletion of intravascular volume. Our body tries to compensate this phenomenon with peripheral vasoconstriction, increase in cardiac contractility and increased in heart rate. Clinically it is presented by increased diastolic blood pressure with slow pulse rate. If volume continues to decrease systolic blood pressure decreases. As a result of this oxygen delivery to vital organs decreases. Due to less supply of oxygen, cells switch from aerobic to anaerobic metabolism which results lactic acidosis. As sympathetic drive increases, blood flow is diverted to vital organs like heart and brain. This further increases the tissue ischemia and ultimately increases the lactic acidosis. If this condition is not corrected, there will be increased hemodynamic compromise and eventually death.

Pathophysiology of neurogenic shock: Neurogenic shock is the most common consequence of traumatic spinal cord injury primary or secondary. 19.3 % cervical spine injuries and 7%

of thoracic injuries presents with neurogenic shock. Sometimes spinal anaesthesia may also induce neurogenic shock. Associated fracture or dislocation of vertebra in the cervical or upper thoracic spine causes the disruption of descending sympathetic tracks. Response to primary spinal cord injury manifests within few minutes of injury. Primary injury is direct damage to the axons and neural membranes in the intermedio-lateral nucleus, lateral grey matter and anterior root that lead to disrupted sympathetic tone. Response of secondary spinal cord injury occurs hours to days after initial traumatic insult. This vascular trauma causes electrolyte shift resulting in oedema which leads to progressive central haemorrhagic necrosis of the grey matter at injury site. A hemodynamic change occurs after injury to the spinal cord above the level of T6. Neurogenic shock is a combination of both primary and secondary injury which results in loss of sympathetic tone and unopposed parasympathetic response driven by the Vagus nerve. It may resolve spontaneously or may cause cardiac arrest leading to death. It presents with bradycardia, hypotension, arrhythmia, hypothermia, fainting and dizziness. It is mainly a vasodilatory shock. According to Aacharya Sushruta there are certain anatomical sites in the body which are seats of life. These are called as Marma or fatal spots, where especially life resides. Hence whenever fatal spots are injured, they produce their respective effects. In general all kind of injuries to fatal spots either produce deformity or death.[1]

ANATOMICAL PERSPECTIVE[1]

Though it is not clearly mentioned which anatomical structure is involved at the sites but we can predict from the effect what must be the structure involved. Like in case of Indra Basti Marma which is present at forearm and calf region respectively, death is said to be due to haemorrhage. Hence we can predict that radial artery and tributaries of cephalic vein in forearm and posterior tibial artery and vein in calf region must be injured to cause the blood loss and hypovolemic shock resulting in death. Similarly in Lohitaksha Marma axillary artery and vein; in Stanarohita Rohita Marma pulmonary and internal mammary artery and vein and ascending aorta, superior vena cava may get injured.

In Katikataruna anatomical structure involved may be superior gluteal artery and vein. In Parshva Sandhi Marma common iliac artery may be injured. Bruhati Marma may comprise of subscapular artery and vein. In Stanamula and Apastambha Marma are present on chest and injury to these Marma causes death after sometime due to respiratory arrest. Though they are mentioned as Sira Marma depending upon the predominance of anatomical structures, we can

conclude that these maybe lung and its appendages as they are causing death by respiratory arrest when injured. Matruka Marma is said to be Sira Marma causing the effects SadyoPranahara. These can be considered as common carotid artery and internal jugular vein respectively. When we consider Hrudaya Marma, it clearly indicates the structure heart, ascending aorta, superior and inferior vena cava and pulmonary veins; which might get injured causing quick death. Also in case of Nabhi Marma, though anatomy is not clearly mentioned; according to the anatomical site we can say that it must be the abdominal aorta.

Basti Marma can be clearly taken as urinary bladder. If it is injured at two different sites, it causes sudden death. When we explore about the bladder injury there are two types of rupture of bladder one is intra-peritoneal and other is extra-peritoneal. Intraperitoneal rupture of bladder will cause the extravasation of urine causing peritonitis, uraemia and death. While extra-peritoneal rupture will cause injury to hypogastric plexus causing hypovolemic shock.

Nitamba Marma is situated at illium and sacrum bone. Structures involved at this site are sacroiliac joint, anterior and posterior sacroiliac ligaments, sacral plexus, psoas major and iliac muscle. Injury to iliac bone and sacral plexus will cause functional loss, wasting of the muscles and death. When we consider the fatal spots situated at the head; we can conclude it as head injuries causing brain insult enough to result in death. Shankha Marma is situated at temporal region. The structures present at this spot are temporal artery as well as anterior and posterior branches of middle meningeal artery. Injury to these arteries is the most common cause of epidural haematoma causing death.

Utkshepa Marma is situated at zygomatic temporal area. Structures like zygomatic artery, temporal artery, internal carotid artery and anterior temporal diploic vein may get injured due to trauma at this site. Sthapani Marma is situated at frontal bone and trauma to this site may injure supra orbital and facial artery. Simant Marma can be considered as coronal, sagittal and lambdoid sutures in the skull. Anterior and posterior superficial temporal and occipital arteries, occipital diploic vein, posterior, anterior and frontal parietal veins are present at this site. Shrungataka Marma is the seat of supra orbital artery, frontal diploic vein and superior sagittal sinus.

PATHOPHYSIOLOGICAL PERSPECTIVE

In addition to mentioning the main anatomical features found at the location of Marma, Sushruta also he addressed the pathophysiology of injury-related death at these sites. He

stated that convulsions will cause when Kshipra Marma got hurt. Sudden blood loss could be the cause of these convulsions. If Talahrudaya Marma is injured, excruciating pain will be the cause of death. When Indra Basti Marma is hurt, there will be a significant blood loss that leads to death similarly, hemorrhage will be the cause of death in the case of Lohitaksha Marma.[6,7] When Guda Marma is injured, it can cause sudden death, possibly from peritonitis.[8] When Basti Marma sustains injuries at two different locations simultaneously, it can result in septic shock or peritonitis, which are both causes of sudden death.[9] The location of Para Ojas, Tamas Guna, Raja, and Sattva is the heart. If any harm at this location results in instantaneous death.[10]

When Stanamula Marma is hurt, it results in emphysema and respiratory arrest, which is fatal. In a similar vein, the Stana Rohita Marma injury results in respiratory arrest and hemorrhage, both of which are fatal.[11] Pneumothorax results in respiratory arrest and death when Apastambha Marma is injured. Damage to Katikataruna Marma results in death from blood loss, which causes the skin to turn white and lose its natural complexion. Trauma at Nitamba Marma results in general debility and lower body wasting, which kills. Intraabdominal hemorrhage is the cause of death when Parshva Sandhi is injured. Injury to Death is considered a consequence of profound hemorrhage in the case of injury at Bruhati Marma. If the trauma object is impacted at the site in the case of Utkshepa Marma, it shouldn't be removed.[12,13] The patient won't survive if the impelled object is removed. Similarly in order to prevent death in the case of Sthapani Marma, the impelled object should not be removed. When Simanta Marma is injured, the result is fear, insanity, loss of consciousness or intellect, and finally death.[14,15]

DISCUSSION

Every Marma has the potential to cause some harm, and treating the resulting pathological changes is challenging, often resulting in complications despite expert care, as emphasized by Sushruta, who highlighted the criticality of the five essential surgical tissues involved in healing.

The convergence of muscles, veins, ligaments, bones, and joints creates Marma points in anatomy, with the human body containing 107 of these points, each linked to various physiological functions. According to Ayurvedic beliefs, these points are vital for maintaining health and vitality as they are connected to the body's energy pathways (Srotas) and life force (Prana). Marma points are categorized based on their size, potential severity of

harm, and location (head, neck, trunk, and limbs). Reported symptoms of Marma injury by Susruta include giddiness, delirium, fainting, delusion, loss of body part activity, semi-consciousness, increased body temperature, weakness of body parts, increased expiration, severe pain, and cessation of activity of all sense organs. These symptoms are commonly reported in trauma cases.[17,3]

If we go through the description of Marma we can finish that Sushruta has stated nearly every cause and pathogenesis of annoying surprise responsible for death. while describing the reasons of death due to harm at fatal spots he has described diverse kinds like hypovolemic surprise, neurogenic surprise and even septicemic surprise. Even as thinking about hypovolemic shock he has mentioned positive Marmas wherein demise takes place due to lack of blood. As an example Kshipra, Indrabasti, Lohitaksha, Stanarohita, ParshvaSandhi, Bruhati. The dying may be unexpected or after some time relying upon the anatomical structures injured. Injury to Talhruday Marma reasons dying because of ache. This could be taken as neurogenic shock. Damage to Basti Marma ends in suppurative pelvic cellulitis inflicting demise due to septic surprise. Also in case of Apalap Marma the dying is due to sepsis. When we recollect the deadly spots situated at the top; we can say that all these are head injuries inflicting mind insult sufficient to bring about death. Trauma on Shankha Marama (that's present between ear and brow) reasons sudden demise as temporal bone is skinny and includes blood vessels of importance (meningeal vessels). Adhipati Marma and Avarta Marma are described as Sira and Sandhi Sannipat. Shrungataka Marma which is thought to be a confluence of sinuses in the skull is also vicinity of extreme sensitivity as it is open sinus with meningeal venous blood. For this reason trauma at these web sites might also grow to be lifestyles threatening.[1]

During the times of Acharyas, vasovagal shock due to pain during surgery must have been a common cause of sudden death so considered it as Sadhya Prana (the breath of life) hara Marma (vital points of the body). Although traumatic lesions involving the anal canal, rectum, perineum, and anus are uncommon but difficult to treat.[18]

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