COMPARTMENT SYNDROMES

An essay

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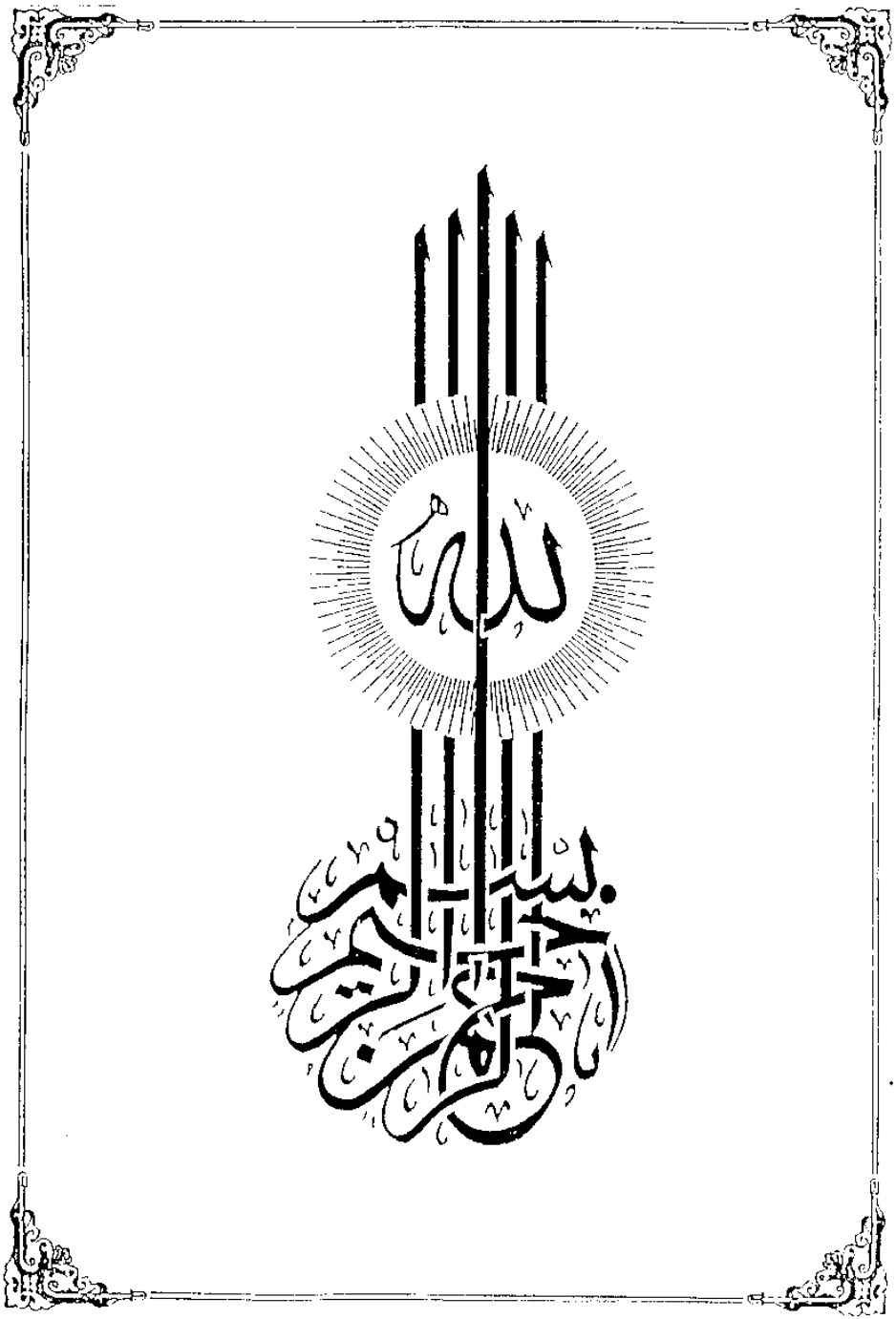

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INTRODUCTION AND HISTORICAL BACKGROUND

Introduction & Historical background

Compartment syndrome is defined as a symptom complex caused by elevated pressure of tissue fluid a closed osseofascial compartment of a limb that interferes with the circulation to the muscles and nerves of that comparment **(Baxter & Rorrabeck 1990) .**

In 1881, Richard von Volkmann described a contracture involving the injured muscles and nerves of the forearm . He felt the contracture was due to the tight application of bandages to the injured limb, thereby causing massive venous stasis and simultaneous arterial occlusion .

Peterson in 1888 , was one of the first to write on surgical management of Volkmann's contracture and demonstrated some return of function following the release of contracted muscle and scar tissue .

Hildebrand in 1906 first used the term Volkmann's ischemic contrature to describe the end point of an untreated compartment syndrome of a limb . Although he had no scientific proof , he thought the initiating event was venous obstruction leading to increased pressure and subsequent arterial compromise to muscle .

In 1909 , Thomas reviewed the medical literature and noted the association of compartment syndrome with a number of medical and surgical conditions including fractures , arterial injuries , embolus , and external compression .

The theory of post ischemic oedema in a limb was proposed by **Rowlands in 1910** and this theory of swelling following restoration of arterial flow to a limb remains accurate today .

Murphy . in 1914 , postulated that release of a compartment by a fasciotomy could prevent muscle ischemia and the subsequent Volkmann's ischemic contracture .

Brooks , thought the precipitating event to be acute venous obstruction resulting in swelling and diminished tissue perfusion . During and shortly after world war II , a number of high velocity gunshot wounds with associated long bone fracture and arterial injury were noted to have developed acute compartment syndrome .The cause of compartment syndrome was thought to be acute arterial spasm , and attention was drawn toward relieving the arterial spasm rather than fasciotomy itself .

Patman and Thompson recommended the cosideration of following peripheral artery reconstruction and thought it had much to offer in maximizing limb function .

Ellis in 1958 , reported a 2 % incidence of ischemic contracture in the lower extremity follwing tibial fractures .Before then , most of the attention had focused on the upper extremity and specifically supracondylar fractures of the humerus and fractures of the radius and ulna as precipitating events leading to compartment syndromes and subsequent contratures .The early clinical and basic research in the lower extremity concentrated on the anterior compartment as the exclusive site of compartment syndrome .

Seddon in 1966 , and kell and whitesides in 1967 , however demonstrated the existence of four osseofascial compartment in the lower extremity and thus the potential need to decompress all four compartments .

Holden , in 1979 , reiterated the two possible causes of compartment syndrome (Volkmann's ischemic contracture) Type I is a proximal arterial injury resulting in ischemia distally , whereas type II is a direct injury giving rise to severe swelling and eventual ischemia .

CLASSIFICATION

AETIOLOGY

INCIDENCE.

Classification of compartment syndromes

Compartment syndromes may be classified as acute or chronic depending on the aetiology of the increased pressure & the duration of symptoms , **(Matsen 1980) .**

Echtermeyer et al ; 1982 found that :-

- **Acute compartment syndrome** may be classified as impending or frank , by the sevreity of it's clinical signs .

* With an impending compartment syndrome :-
  - Peripheral blood flow is not yet diminished .
  - Neurologic deficits are absent or mild .
  - A cardinal feature is pain that is out of proportion to the primary injury .
  - Pressures measured in the fascial compartments are in the high normal range 30 - 40 mmHg has been empirically defined as the critical pressure **(Mubarak et al ; 1978 ; Akeson et al ; 1981) .**

* In frank compartment syndrome :-
  - Significant neurologic deficit has already developed .
  - Disturbances of blood flow are apparent .

- **Chronic compartment syndrome :-**

Chronic compartment syndrome first described by **Mavor in 1956** . characterized by pain induced by exercise swelling & impaired muscle function **(Reneman , 1975)** .

Mubarak & Hargens' (1981) have found that chronic compartment syndrome is defined as a condition in which exercise elevates intermuscular pressure to an extent that ischemic pain occurs .

Aetiology

Two factors are essential to the pathogenesis of a compartment syndrome **(Baxter & Rorabeck 1990)**

a) An envelope which encloses a circumscribed space which may be :

* Epimysium
* An osseofibrous sheath like that in the anterior tibial compartment
* Fascia alone , as in gluteal compartment
* Skin or a constricting dressing may create a limiting boundary .

b) An increase of tissue pressuer within that envelope may be caused either by :

1- Intrinsic factors :-

Are those that lead to an increaced compartment content

- Haemorrhge - following fracture or severe soft tissue injury
- Accummulation of oedema fluid within a compartment such as occurs with post ischemic swelling after arterial injury .

Initially , an increase in compartmental contents is associated with only a slight rise of intercompartmental pressure , apparently owing to the large compliance of the investing fascia . But as the volume of the contents continues to expand , the pressure within the compartment begins to rise exponentially .

2 - Extrinsic factors :-

When the volume of the compartment decreased such as :-

1- Surgical closure of fascial defects .

2- Excessive limb traction in treatment of fracture .

3- Casts or bandages that are excessively tight and do not allow the compartment to expand .

4- Recently pneumatic antishock garments **(Kunkel 1987)** .

In children number of other unusual causes of compartment syndrome have been documented following tibial osteotomies ,**(Gibson 1986 - Heim et al 1986)** and hereditary bleeding disorders .

**** High risk for developing compartment syndrome :-**

1- Vascular injuries in the peripheral ischemia .

2- High energy traumata .

3- " Bumper " injuries causing segmental fracture of the tibia , constitute typical high risk situation .

4- Comminuted fractures of the distal tibia .

5- Multiply injured patient due to reduced peripheral flow . **(Echtermeyer et al ; 1984) .**

Aetiology of chronic compartment syndrome

The aetiology of chronic compartment syndrome is not known , for some reasons , the volume of muscle increases abnormally during excercise and thereby increases the pressure within the closed compartment . Chronic compartment syndrome is caused insufficient perfusion of tissue with blood during exercise due to the elevated interamuscular pressure . A pathological increase of the muscle - relaxation pressure in patients with this syndrome has been shown to reduce the flow of boold in muscle **(Styf et al 1987) .**