Anesthetic Considerations in Patients with Heritable Connective Tissue Disorders

An Essay

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Ahmed El Sayed El Shafeey

بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ

﴿وَعَلَّمَكَ مَا لَمْ تَكُنْ تَعْلَمُ وَكَانَ فَضْلُ اللَّهِ عَلَيْكَ عَظِيمًا﴾

صدق الله العظيم

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List of Abbreviations

Abb.	Meaning
ACE	Angiotensin converting enzyme
ADH	Antidiuretic hormone
ADP	Adenosine diphosphate
ARB	Angiotensin receptor blocker
BP	Blood pressure
CCA	Congenital contractural arachnodactyly
COX	Cyclooxygenase
CSF	Cerebrospinal fluid
CT	Computerized tomograghy
CVP	Central venous pressure
CXR	Chest x ray
DIC	Disseminated intravascular coagulopathy
ECG	Electrocardiogram
EDS	Ehler Danlos syndrome
EN	Enteral nutrition
FBN	Fibrillin
FDA	Food and drug administration
FEV_1	Forced expiratory volume in one second
FVC	Forced vital capacity
HDU	High dependency unit
ICU	Intensive care unit
IV	Intravenous
JHS	Joint hypermobility syndrome

List of Abbreviations

Abb.	Meaning
MFS	Marfan syndrome
MRI	Magnetic reonance imaging
MVP	Mitral valve prolapse
NCA	Nurse controlled analgesia
O_2	Oxygen
OI	Osteogenesis imperfecta
PACU	Post anesthesia care unit
PCA	Patient controlled analgesia
PDPH	Post dural puncture headache
PN	Parentral nutrition
PONV	Post operative nausea and vomiting
POTS	Postural orthostatic tachycardia syndrome
SLE	Systemic lupus erythromatosis

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INTRODUCTION

Connective tissue is any type of biological tissue with an extensive extracellular matrix that supports, binds together, and protects organs. These tissues form a framework, or matrix, for the body, and are composed of two major structural protein molecules: collagen and elastin. There are many different types of collagen protein in each of body tissues. Elastin has the capability of stretching and returning to its original length like a spring or rubber band. Elastin is the major component of ligaments (tissues that attach bone to bone) and skin ***(William & Shiel, 2014).***

Connective tissue varies from the skin below the eye to dense tendon, and consists of: cells, fibers and ground substance, all these components are under physiological and hormonal control ***(Watkins & Salo, 1982).***

A connective tissue disease is any diseases that have the connective tissues of the body as a target of pathology. In patients with connective tissue disease, it is common for collagen and elastin to become injured by inflammation. Many connective tissue diseases feature abnormal immune system activity with inflammation in tissues as a result of an immune system that is directed against own body tissues ***(William & Shiel, 2014).***

Disorders of the connective tissue elements themselves comprise two contrasting groups, the very common degenerative diseases such as Rheumatoid Arthritis, Scleroderma and Systemic Lupus Erythromatosis and the rare inherited connective tissue disorders such as Marfan syndrome, Ehler Danlos, benign joint hypermobility syndrome and osteogenesis imperfecta ***(Watkins & Salo, 1982).***

Patients with connective tissue disorders require surgical operations more frequently and they may present with many potential problems. A few minutes of careful questioning and examination preoperatively may prevent a tragic situation. A history of drug therapy is essential preoperative information, particularly since many of these patients will need augmentation or coverage with steroid drugs. The anesthesiologist must be aware of patient general state of health and must search for evidence pulmonary, cardiac or hematological abnormalities. Patients with connective tissue disorders are systemically and often chronically ill and many conditions such as anemia, hypovolemia and hypoproteinemia may influence the anesthetic technique. For instance, patients with pulmonary or cardiac manifestations may put them at added anesthetic risk ***(Roelofse & Shipton, 1985).***

AIM OF THE ESSAY

The goal of this essay is to focus the light on heritable connective tissue disorders, principal features of them; their clinical and prognostic similarities and differences, and their distinguishing features.

Also, this essay draws an attention to anesthetic problems, complications and situations that may face the anesthesiologist in assessment, evaluation and management of such types of patients with heritable connective tissue disorders intra- & post- operatively.

HERITABLE CONNECTIVE TISSUE DISORDERS

A connective tissue disease is any disease that has the connective tissues of the body as a target of pathology. Connective tissue is any type of biological tissue with an extensive extracellular matrix that supports, binds together, and protects organs. These tissues form a framework, or matrix, for the body, and are composed of two major structural protein molecules: collagen and elastin. There are many different types of collagen protein in each of the body's tissues. Elastin has the capability of stretching and returning to its original length like a spring or rubber band. Elastin is the major component of ligaments (tissues that attach bone to bone) and skin. In patients with connective tissue disease, it is common for collagen and elastin to become injured by inflammation ***(William & Shiel, 2014)***.

Many connective tissue diseases feature abnormal immune system activity with tissue inflammations as a result of an immune system that is directed against one's own body tissues (autoimmunity). Diseases in which inflammation or weakness of collagen tends to occur are also referred to as collagen diseases. Collagen vascular diseases can be (but not necessarily) associated with collagen and blood vessel abnormalities that are autoimmune in nature. Connective tissue

diseases can have strong or weak inheritance risk, and can be also caused by environmental factors ***(William & Shiel, 2014)***.

Thus, Connective tissue disorders are classified into two main categories: auto immune coonective tissue disorders and heritable connective tissue disorders**.** The autoimmune connective tissue disorders may have both genetic and environmental causes. Genetic factors may create a predisposition towards developing these autoimmune diseases. They are characterized as a group by the presence of spontaneous overactivity of the immune system that results in the production of extra antibodies into the circulation. The classic collagen vascular diseases include systemic lupus erythematosus (SLE), rheumatoid arthritis, scleroderma, sjögren's syndrome, mixed connective tissue disease and Psoriatic arthritis ***(William & Shiel, 2014)***.

Heritable connective tissue disorders include Marfan syndrome (MFS), Congenital contractural arachnodactyly (CCA), (also known as Beal's syndrome), Ehlers Danlos syndrome (EDS) and Osteogenesis imperfecta (OI) (brittle bone disease). Marfan syndrome is a genetic disease causing abnormal fibrillin. Congenital contractural arachnodactyly is akin to Marfan syndrome but with contractures of hip, knee, elbow and ankle joints and crumpled ear. Ehlers Danlos syndrome caused by a defect in the synthesis of collagen (Type I or III) resulting in progressive deterioration of collagens, with

different EDS types affecting different sites in the body, such as joints, heart valves, organ walls, arterial walls. Osteogenesis imperfecta is caused by insufficient production of normal collagen (primarily type I) to produce healthy, strong bones ***(William & Shiel, 2014)***.

1) Marfan Syndrome (MFS)

Marfan syndrome **(Figure 1)** is the most common inherited connective tissue disorder, with a reported incidence of 1 in 10,000 individuals with equal distribution between the sexes. It is caused by an autosomal dominant mutation in the gene encoding fibrillin (FBN1, chromosome 15q15– 21.3). Fibrillin is a glycoprotein that is an integral part of the connective tissue in the body (e.g., ligaments, blood vessels and eye lenses). Although the genetic and biochemical bases of the condition have been identified, the disease continues to be under diagnosed. If unrecognized, patients with Marfan syndrome may potentially develop aortic rupture or sudden cardiac death. Therefore, it is important to identify this potentially life threatening condition ***(Brad & Howard, 2013)***.

Ghent Diagnostic Criteria for Marfan syndrome (MFS): **(Tables 1- 4):**

It was modified by loeys, et al in 2010 and the last revision was by radonic, et al in 2011. The Ghent criteria consist of major and minor criteria. The major criteria are

features or symptoms that are common in people with Marfan syndrome and rare in people who do not have the syndrome. Minor criteria are features or symptoms that are present in people with Marfan syndrome, but are also present in people who do not have it. For diagnosis of Marfan syndrome using the Ghent criteria, one must have a number of different criteria **(Tables 1- 4)**. If there is a family history of Marfan syndrome, one needs to have one of the major criteria and one of the minor criteria that affect different systems in body, such as skeleton and blood vessels. If the person does not have a family history of Marfan syndrome, one needs to have two major criteria and one of the minor criteria that affect different systems in the body ***(Loeys et al., 2010)***. The last revision of Ghent criteria was by ***Radonic et al., 2011*** giving more weight on size of aortic root & ectopia lentis.

Figure (1): Marfan syndrome ***(Bonow et al., 2006)***