METABOLIC CAUSES OF CALCULOUS DISEASES

Thesis

Submitted for Partial Fulfilment

for the Degree of Master in

(UROLOGY)

By

Essam Eldin Abdel Salam Ismael

M.B.,B.Ch.

Under the Supervison of:

Prof. Dr. Hatem El-Bealy, Prof. of Urology, Faculty of Medicine, Ain Shams University.

Faculty of Medicine

AIN SHAMS UNIVERSITY

1983

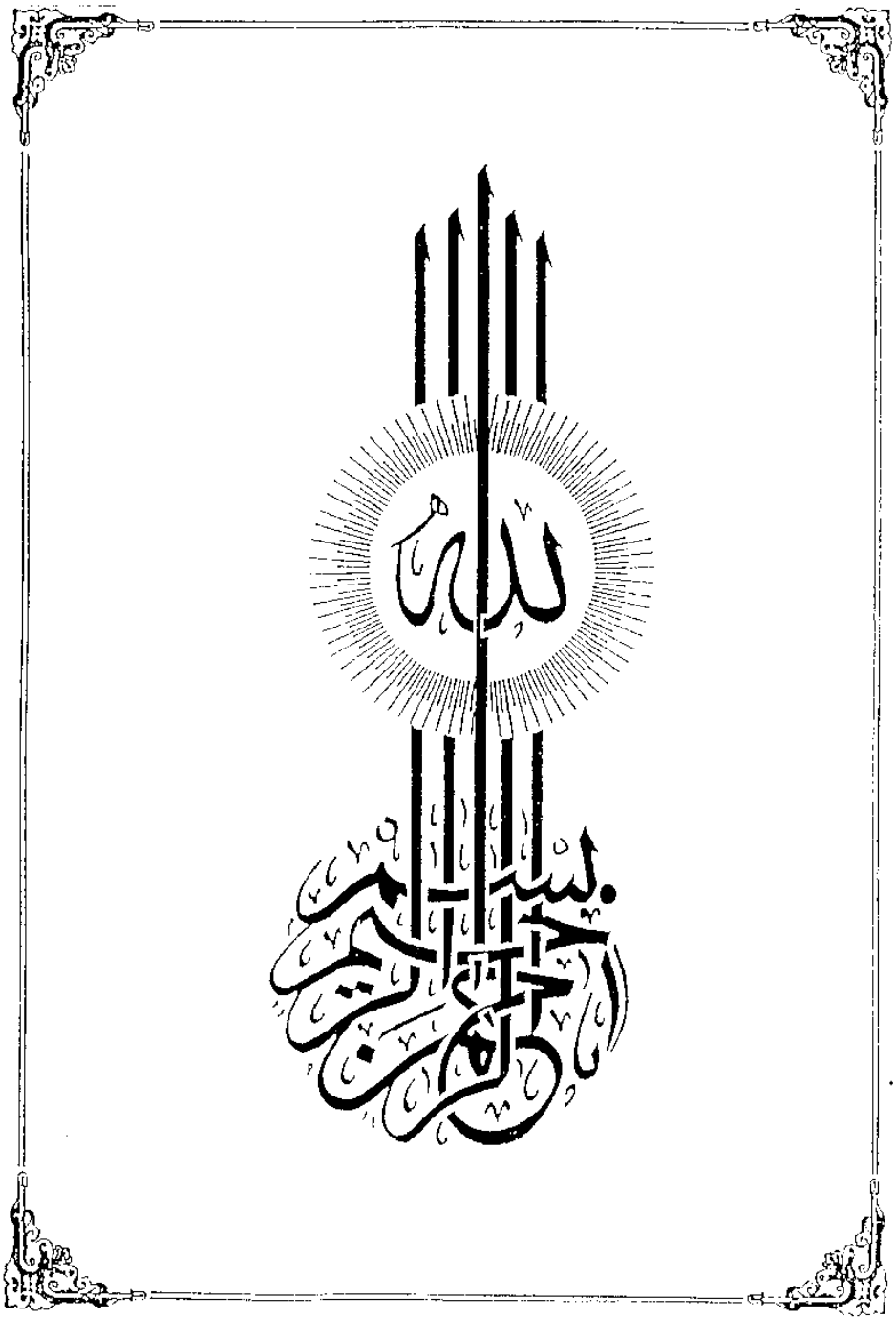
ACKNOWLEGEMENT

My gratitude and thanks for God for his kind support to me.

, I wish to express my sincere gratitude to Professor Ali Magid the Chairman of Urology Department, Faculty of Medicine , Ain Shams University.

My greatfull thanks to professor Hatem Elbealy for his contineous encourgment, valuable suggestions and close supervision.

Finally I am very thankfull to all members of Urology Department.



Content

HISTORICAL REVIEW

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Urolithiasis is an ancient problem, Riches (1968) refers to a stone that was found in the pelvis of an Egyptian skeleton estimated to be over 7000 years old.

An earliest evidence also dates to before 4800 B.C. and was a bladder stone found among pelvic bones of a young Egyptian. Another stone dating about 4200 B.C. was probably of renal origin and analysis revealed it to be composed of calcium carbonate, calcium phosphate and calcium oxalate (Shattock, 1905).

Hippocrates was the first to theorize the aetiological factors of urinary lithiasis. He observed that many patients having calculi in the bladder or kidneys had sandy sedement in their urine and suggested that the ingestion of muddy river water or water containing lime caused stone formation in the urinary tract (Butt, 1956).

According to Hippocrtes admonition, many lithotomists were trying for surgical removal of stone bladder for many centuries. By 17th and 18th centuries

many of these men had become famous, some of the famous lithotomists including Colot, Fr. Jaques, Rau, Fr. Come and others. (Wangesteen et al., 1969).

Many of these indeviduals were well trained and "professionals" and according to Wangesteen et al., they began to take an interest in urinary lithiasis. Most of their interest centered upon improvement technique for removal of bladder calculi.

Medieval physicians attributed stone formation to a variety of causes : excess salt intake, excess heat, the presence in the urine of matter obstructing the kidneys. With increased knowledge of the anatomy of urinary tract and an understanding of renal physiology, modern physicians began to differentiate between kidney stones and bladder stones and this altered their concepts regarding those factors they believed to influence stone formation. This is according to Ron Delt who was a Frensh physician practising in the 1500s (Murphy, 1972).

Jean-Baptiste van Helmont (1571-1644) was the first to suggest that stone formation resulted from the excretion of abnormal material in the urine (Butt,

1965). He observed that stone formation was associated with the presence of multiple factors, and the composition of the stone reflected to the presence of multiple substances found in the urine. These necessary urinary factors were :(1) the spirit of urine (uric acid), (2) the coagulating spirit (alchol), (3) a ferment causing decomposition of urine. He also reported the presence of a nucleus or core of the stone and progressive growth of the stone was dependant on the presence of a ferment causing decomposition of the urine.

The first investigator who demonstrated the structural complexity of urinary calculi was Anton Von Heyden in 1684 (Butt 1956). He removed the crystalline components from stones without destroying the gross structure and termed the remaining substance the "framework" of urinary calculi.

Celsius, Franco, and Cheselden improved lithotomy tichniques. Civiale and Biglew developed practical lithotrity and lithopaxy techniques that are still used. Sir Henery Thompson was interesting in medical therapy of bladder stone by dissolution. (Thombson, 1873, cited by Throwald,I965).

Glen treated stone diseases by urine and honey, passary, corway seeds; and Howship tries to administrate alkalies or acids to arrest calculi, as did sir Asly Cooper (cited by Wesson, 1935).

Streitze and associates report on the composition of a bladder stone in young American man who died from dust inhalation 1500 years ago. The bladder stone in this unpreserved mummy was composed predoninatly of calcium oxalate monohydrate, although minute quantities of struvite, carbonate apatite and urate also were present.

Bladder stones were prevalent in Europe in mideval times and continue to be predominant in geographical areas where socioeconomic factors result in unbalanced diets. Such endemic bladder stones are characteristically composed of calcium oxalate and/or urates (Donald, P. Griffith, 1981).

Europeans brought their predisposition to form bladder calculi to America. Wangesteen et al., (1906) summarized several reviews of lithotomy practice in America during the years of 1810 to 1835.

Vogel (1970) noted that in America urinary calculous disease was isolated predominatly to immigrant Europeans.

In 1559, an Inca reporter (cited by Vogel) thought that corn was the factor which prevented occurrance of urinary calculi in native American Indians. Many Indian Herbal treatments were adopted to the treatment of urinary calculus or gravel by the Americans, thus Vogel reported the use of how or howthorne tree, persimmon, sarsaparilla, and decoctions of multiple other leaves and twigs as remidies for stone.

Beck and and Mulvaney (1966), reported two urinary calculi associated with the bony remains of two Indians buried in Fulton County, Illinois and Marion County, Indiana. Both stones were predominatly carbonate apatite, although one contained a small amount of struvite. Dating of these stones, one at 1500 B.C. and the other 1500 A.D. Since pure apatitic calculi usually accompany metabolic disease, it seems possible that these calculi were caused by such a disease and that indeed idiopathic.

Prien (1971) and Joly (1931) reported the importance of geographic distribution of urinary calculi.

The bladder calculi were an endemic part of life prior to 20th century (Ellis, 1969, Ostergaard, 1973).

King (1971) and Prien (1971) noted the historical trend away from bladder calculi toward upper urinary tract calculi whenever the country becomes more industarialized and the diet becomes more nutritious.

By the early 1900s, observers of urinary stone disease had already began to notice an increased occurrance of bladder calculi in Europe, the British isels and America. This change seems to be parallel with increased industrialization (Campell's U., 1978).

By 1950 investigators began to report some significant physiologic observations that were associated with the production of urinary calculi. (Gutman and Yu, 1968).

Hypercalcuiria was defined as one factor contributing to the formation of calcuim calculi (Folks, 1939).

The importance of nucleation of stones in the kidney was studied by Randall (1937).

Urinary crystals and calloids were described, and crystalloid and colloid composition of all stones was determined by (Wisson, 1935).

The effects of infection in stone formation and their difference from excessive excretion of crystalloid in sterile urine, aetiology, prophylaxis of stone formation progressed after World War II. (Campel's U. 1978).

CALCULOUS DISEASES

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Definition of a Urolith :

Uroliths are solid structures that arise from disturbances of the physiochemical balance and/or the hydrodynamic system of the urine, and the urinary tract form the collecting system down to the ureth ra. These structures have a minimal size of 1,000 um and consist mainly of crystalline and to a lesser degree, of amorphous organic and/or inorganic components, which may be mixed with a non crystalline high molecular substance (matrix) (Hans-Joachim S., 1982).

General structure of renal calculi :

The definitive stone is formed mainly in the lower calyx of the kidney, less commonly in more than one calyx more or less similutaneously, and not infrequently in one or more calyces of both kidneys at approximately the same time or separated by interval of time.

Renal calculi are composed of one or more cyrstalline substances (probably reflecting their aetiology) admixed with colloidal matrix, usually 2.5% of the whole.

The stone at first small, usually solitary (but

occasionally multiple), hard, flat, pyramidal or concavo-convex and often attached to the renal papilla (at least at first) and gradually enlarged to fill a calyx.

A stone in the renal pelvis may at first be small (being migrating from a calyx) but gradually enlarged and often takes the shape of the pelvis.

The staghorn calculus has prolongations or separate calculi in the calyces, the colour varies according to the chemical composition and may be modified by superfiscial coating of blood pigment pus, or fibrin.

1- Crystalline content :

At least 11 different crystalloid substances may enter into the composition of the stone. Occasionally advintitious substances (including drugs such as sulphonamides, tetracycline, methyline blue or prophyrin) may also be incooperated into a calculus.

The stone usually has a nucleus which may differ in composition from the remainder of the stone. When cut across some stones show radial striations (calcium