" RISK FACTORS IN THE FORMATION OF URINARY STONES "

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ADEL SAMUEL SALIB

(M.B.B.CH.)

SUPERVISED BY

PROF. DR. IBRAHIM RAGI

PROFESSOR OF UROLOGY

CHAIRMAN AND HEAD OF UROLOGY DEPARTMENT

FACULTY OF MEDICINE

AIN SHAMS UNIVERSITY

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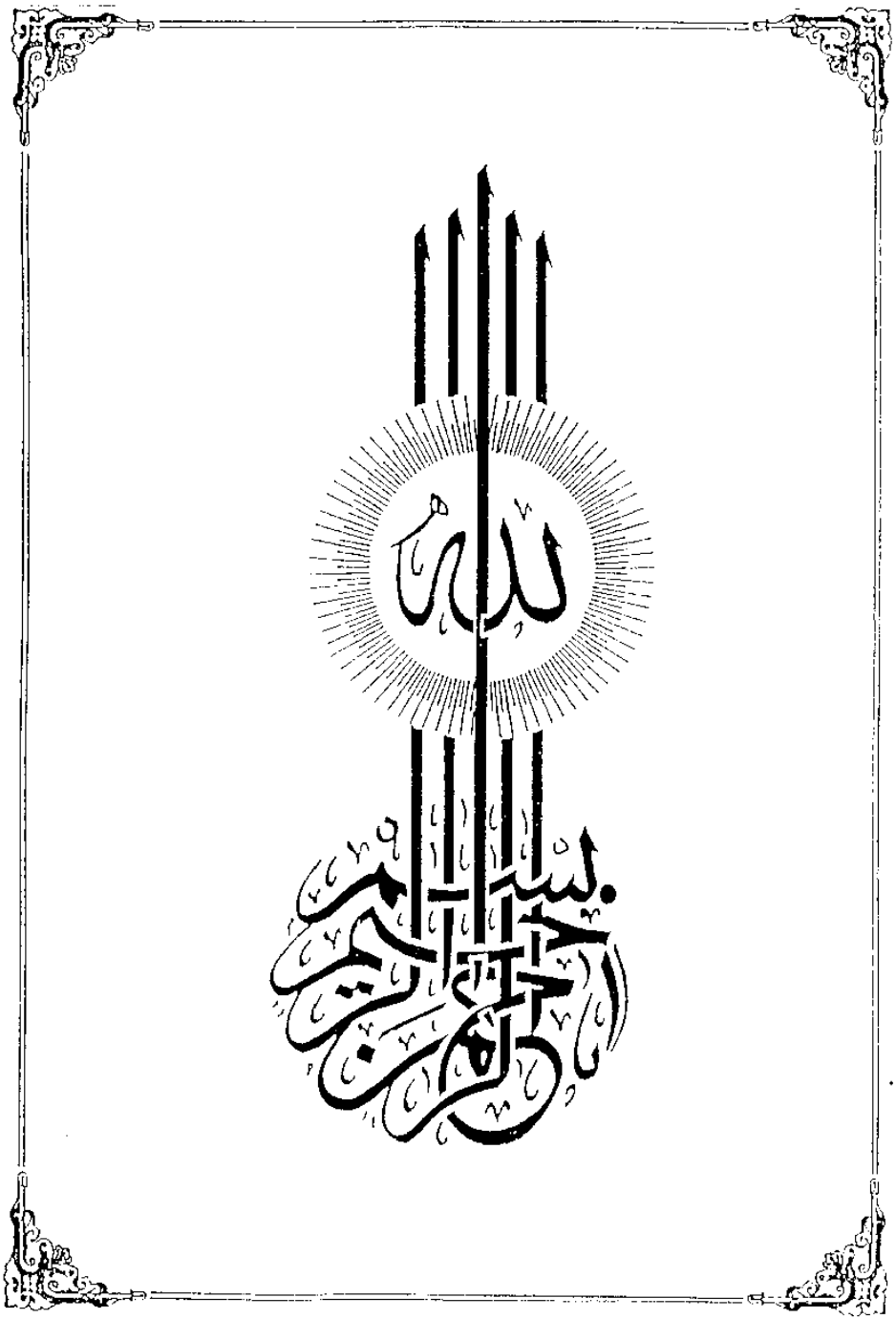
DEDICATED TO

DR. KOSMAN AND DR. DOMIAN

THE MERCIFUL DOCTORS.



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CONTENTS

EPIDEMIOLOGY OF UROLITHIASIS

EPIDEMIOLOGICAL ASPECTS OF UROLITHIASIS

The problem of urolithiasis has been of considerable interest to epidemiologists. Their data has not solved the aetiological mysteries but interesting variations have appeared when historical, geographical and occupational aspects are studied and when community surveys are undertaken.

Andersen (1973) presents an interesting multi - faceted theory of epidemiology of urinary calculi. He feels that there are at least two separate epidemiologic factors involved in the genesis of urinary calculi. The first of these may be considered intrinsic. Intrinsic factors are related to the inherited biochemical or anatomic makeup of the individual. Intrinsic factors include : heredity, age and sex. The effects of these factors on incidence of calculi will be discussed.

Andersen terms the other factors, extrinsic or environmental factors. These include: geographical distribution of this disease and the influence of climate and different occupations on the occurence of urinary lithiasis and the relationship between water intake and diet with urolithiasis.

Intrinsic Factors

Heredity

Familial associations have been described and Ljunghall and Hedstrand (1975) found renal stones in at least one first degree relative in 29.4 % of stone patients compared with 15.3 % of a stone free control population.

Multiple recurrence of renal stone is also more common in patients with a family history of stones and the early recurrence rate in them is also significantly greater. This probably indicates inherited predisposing factors and a hereditary form of hypercalciuria has been described. A number of authors conclude that urolithiasis requires a polygenic defect (more than one gene is involved). In addition genetic predisposition to urinary lithiasis has partial penetrance, so that the severity of stone disease may differ from generation to generation even though the individual has the gene defects necessary for urinary lithiasis. (Resnick, et al 1968) and (Mc Geown, 1960).

Coe et al (1979) observed a familial form of idiopathic hypercalciuria and concluded that it was transmitted as an autosomal dominant trait stones being frequent in first degree relatives and affecting both

sexes equally. However White et al(1969) caution against accepting familial or hereditary theories of stone formation. He observed increased urinary risk factors to calcium oxalate stone in the spouses of stone formers suggesting a household factor, likely to be dietaryhabit.

Renal tubular acidosis is one hereditary disease that has certainly been associated with frequent episodes of urinary lithiasis. Nephrolithiasis and nephrocalcinosis have been reported to occur in almost 73 per cent of patients with the disease (Marquardt 1973). Incomplete renal tubular acidosis also appears to be transmitted as a hereditary trait that results in urinary lithiasis. Cystinuria is a prime example of familial transmission of a type of urinary lithiasis that is definitely hereditary (Drach, G.W. 1978).

Age and Sex

Several authors have pointed out that the maximum incidence of urinary lithiasis appears to occur in the third to fifth decades with a male to female ratio is 3:1 . (Bailey,et al 1974) and (Burk land and Rosenberg 1955).

However the incidence ofupper urinary tract calcification is approximately equal in males and females at the time of autopsy (lonsdale,1968 b). Lonsdale (1968 b) added the fact that in females most upper

urinary tract calculous disease is caused by chronic urinary tract infection or metabolic defects such as cystinuria or hyperpara thyroidism and he recognized that most upper urinary tract lithiasis throughout the world is accounted for by recurrent idiopathic calcific or uric calculi in males.

Several authors have commented upon the apparently equal tendency toward urinary lithiasis in males and females during childhood (Malek and Kelalis 1975). This observation coupled with reports that increased serum testosterone levels resulted in increased endogenous oxalate production by the liver (liao and Richardson 1972).

Finlayson (1974) postulate that lower serum testosterone levels may contribute to some of the protection Women and Children enjoy against oxalate stone disease. Recent reports have demonstrated that increased urinary citrate concentrations in the urine of females may aid in protecting females from calcium urolithiasis. (Welshman and Mc Geown 1975).

Extrinsic Factors

Geography

Finlayson (1974) performed an extensive study of the incidence of calculous disease in the world he found

that there is a noticeable increase in urinary calculi in mountainous or tropical areas. He stated that the united states is relatively high in the incidence of urinary calculous disease for its population. Other high incidence areas are the British isles, Scandinavia, the Mediterranean countries, northern India, Pakistan, northern Australia, central Europe, portions of the Malayan, Peninsula and China. In certain other areas of the world there is a relatively low occurence of idiopathic urinary lithiasis. Low incidence areas include central and south America, most of Africa and those areas of Australia populated by native aborigines. Many of the areas with a low incidence of stone disease have warm climates and large populations of native inhabitants.

In addition to different incidences for all urinary calculi combined there are differences in types of urinary stone disease in different areas of the world. Many authors have reported extensive geographic surveys of types of urinary calculi. They have noted that stones from Great Britain, Scotland and the Sudan are similar and are composed primarily of mixed calcium oxalate and calcium phosphate (Sutor and Wooley 1974) and (Lonsdale 1968 a and b). Sutor (1974) note that many oxalate but few struvite calculi were found in stone collections of the Royal Navy. He also stated that approximately 80

per cent of the stones from children who are lived in under-developed areas such as Thailand contained ammonium acid urate or calcium oxalate or both.

Upper urinary tract calculi composed of uric acid tend to be more common in certain geographic areas. Representative areas include Czechoslovakia and Israel and possibly chicago (Gutman and Yu 1968). Conversely others report that upper urinary tract calculi analyzed in India contained mostly calcium oxalate or calcium phosphate (Hazarika, et al 1974).

Climate

It is not easy to attribute a high incidence of patients with urolithiasis in any given country to climatic conditions alone. Since in every country other factors such as diet, race and ethnic factors play their part. Dry heat or humid heat results in loss of water by way of the skin through sweating and by way of the breath through respiration so that even with a high daily intake of liquid. Subjects in hot countries passhighly concentrated urine (usually acid in reaction) perhaps only once in 24 hours or even longer. Crystals may therefore be deposited in the urine which predispose to renal stoneformation. Paradoxically however even in very hot countries urolithiasis may be uncommon. During 1 year's hospital practice in Ecuador a tropical country among

60.000 people observed, Davols (1954) did not encounter a single patient with urinary calculus. The contradictions inherent in the problem are shown by his observation that in south America stones were common in north east Brazil but rare in the Amazon valley and also in Panama where the climate is hot and humid all the year round. In northern Peru, with its Warm dry climate urinary calculi are rare.

An increased incidence of acute renal colic (with ureteric stones)was observed by one group during hot weather 135 cases annually during a 6 year period having been seen (Prince et al 1956). A 50 % increase in the incidence of urinary calculi was observed in the Pensacola region of Florida during the hot season (leonard 1961).

The incidence of renal stone is sometimes increased to an abnormally high level in military and naval personnel who are moved for long periods (as during wars) from more temperature zones to tropical or subtropical regions. A high incidence of renal calculi has been found among American soldiers living in a desert area where the heat in summer was almost intolerable.

During world war II a high incidence of renal and ureteric stone among British troops in north Africa and Egypt many of whom had not previously been exposed to tropical heat was observed.

Water intake and urinary lithiasis

Two factors involved in the relationship between water intake and urolithiasis :

are : 1- The volume of water ingested.

and : 2- The mineral or trace element content of the water supply of the region.

The volume of Water ingested

Increased water intake and increased urinary output decrease the incidence of urinary calculi in those patients who are predisposed to the disease (Burkland and Rosenberg 1955).

Finlayson (1974) points out the theoretical criticism that urine dilution by increased water intake may actually increase ion activity coefficients of the elements in urine. Ion collisions would increase and might contribute to increased formation of crystals. But water diuresis does reduce the average time of residence of free crystal particles in urine and also dilutes absolutely the components of urine that may crystallize. Finlayson concludes that the dilutional effects of water diuresis probably outweigh the changes in ion activity and therefore do help to prevent stone formation.

Lonsdale (1968 b) pointed out that habitual low levels of water intake may have been related to the high incidence of uric acid stones of British adults in earlier times .

The mineral content of water

Some investigators say that excessive water hardness (usually calcium sulfate) contributes to calculi. While others say that excessive softness (as when sodium carbonate is predominant) causes increased incidence of stone disease (Rose and Westbury 1975). Additionally the presence or absence of certain trace elements in water has been implicated in the formation of urinary calculi. Low urinary levels of zinc could increase a tendency toward stone formation as zinc is an inhibitor of calcium crystallization (Elliot and Eusebio 1967).

Diet

Considering the role of diet in stone formation there is still a major debate between different authors. Some of them consider diet play a major role while others disregard this conception.

The old conception : claims that stone formation is dependent to a great extent on the ingestion of the chemical substances from which the stones are formed. The commonest components