A CHEMICAL AND PHYSICAL STUDY OF RENAL CALCULI IN EGYPT

THESIS

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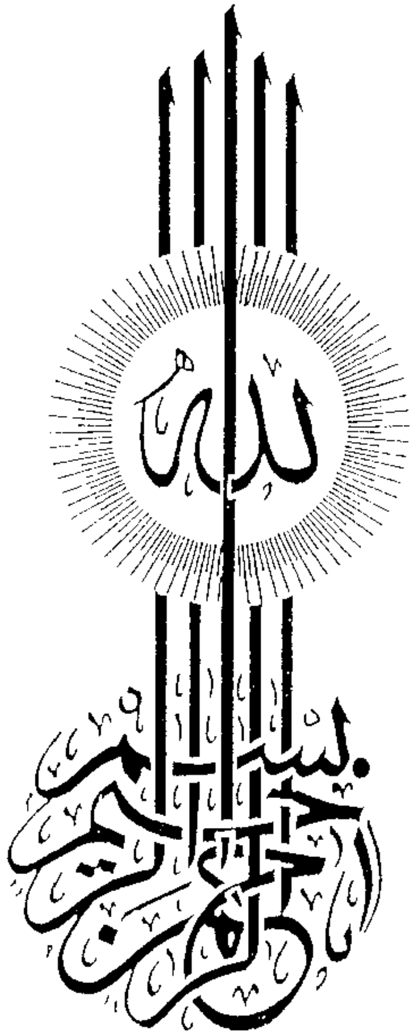
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CONTENTS

INTRODUCTION

Being a stone bearing area, the research work in Egypt should have lithiasis as one of its objectives.

Therefore this work is aimed to identify the chemical and infrared spectroscopic pattern of renal calculi in the Egyptians.

The work will include the analyses of the stones by the conventional chemical method and by other physical methods as the polarising microscope and infrared spectroscopy.

A comparison will be done between the various methods for accurate identification of chemical constituents of lithiasis. Also an attempt is made to explain the potential mechanisms which help shaping calculi into comma, branched, spherical and jack stone forms. Revealing such processes would assist the clinician facing problems of growth, surgical removal and the prevention of stones.

REVIEW OF LITERATURE

EPIDEMIOLOGIC ASPECTS OF UROLITHIASIS

The incidence of upper tract urinary calculi varies greatly with age, sex and geographic distribution. Also there are certain stone waves or flares during different periods of history. Therefore Andersen (1973) felt that at least two separate epidemiologic factors are involved in the genesis of urinary calculi. The first of these may be considered intrinsic as the effect of heridity, age and sex on the incidence of calculi. The second factor being extrinsic or environmental including climate, water intake, dietary pattern, effect of geography and different occupations.

I- Intrinsic Factors

1- Heredity

Urinary calculi are noted to be relatively rare in the African Bantu natives (Modlin, 1969), the related North America negro and the native born israeli (Frank et al., 1959). It seems that resistance to urinary stone disease is part of the natural selection of individuals for persistence of their race in areas having relatively hot climate. Conversely the stone disease is common in some colder areas of the world, as Holland and Scotland.

The familial incidence of urinary stones in relation to heredity has been studied by McGeown (1960) and Resnick et al. (1968). They concluded that urolithiasis requires a polygenic defect. Furthermore they found that the stone incidence is higher in the families of stone forming patients than those of non stone formers. Pridgen et al. (1968) showed that the parents and siblings of stone formers more often produced stones than the corresponding relatives of the spouses of patients.

Renal tubular acidosis is one example of a hereditary disease associated with stone formation. Also cystinuria is another example of familial transmission of a type of urinary lithiasis that is definitely hereditary. It is a homozygous recessive disease. The genetic defect is that of excessive excretion of cystine, ornithine, lysine and arginine. Only cystine becomes insoluble in urine. Strangely enough the great majority of cystinuric patients do not develop urinary calculi (King, 1967). It appears that at least two gene defects are required to predispose some cystinurics towards formation of cystine calculi, and only patients carrying the additional genetic defect that forms these stones.

2- Age and sex

Blacklock (1969) found that the peak age incidence of urinary calculi occurs in the third to fifth decades and that about three males are affected for every female. These findings are confirmed by the work of several authors (Burkland and Rosenberg, 1955; Frank et al., 1959; Prince and Scardino, 1960).

The tendency towards stone formation in childhood is apparently equal, as regards sex, as reported by Prince and Scardino (1960). Finlayson (1974) explained this observation on the basis that lower serum testosterone levels in women and children may play a role in the protection against lithiasis.

Furthermore Welshman and McGeown (1976) have demonstrated increased urinary citrate concentrations in the urine of females, and they postulated that this may aid in protecting females from calcium urolithiasis.

II- Extrinsic Factors

1- Geography

Geography has some influence on the incidence of urinary calculi and on the types of calculi that occur within a given area.

In reviewing geographic surveys Finlayson (1974) stated that high incidence areas for urinary stone disease include the British Isles, Scandinavia, Mediteranean countries, Central Europe, northern Australia and the United

States. Low incidence areas include central and south America, most of Africa and those areas of Australia populated by native aborgines.

Andersen (1969-1973) emphasized the difference of stone incidence pattern in the industrialized and developing groups of countries. Whereas in the European countries there has been in the last century a major change in the recorded pattern of stones from a predominance of calculi of the lower urinary tract in the early century to a predominance of stones of the upper urinary tract today. This contrasts with the present position in India and Thailand where vesical stones are commoner than upper urinary tract stones.
The pattern in countries of intermediate economic development, as the Middle East, shows a moderate incidence and that the change of pattern has taken place about fifty years later than in Great Britain and is still incomplete.

Stones from Great Britain, Scotland and Sudan are similar and are composed mainly of mixed calcium oxalate and calcium phosphate. In other areas of the world most upper urinary tract stones are composed mainly of magnesium ammonium phosphate (Suter and Wooley 1970b, 1971). Upper urinary tract calculi composed of uric acid tend to be more common in Israel and Czechoslovakia.

2- Climatic factors

Climate is found to influence the prevalence of urolithiasis. Blacklock (1969) in a survey on personnel of the Royal Navy found an increased incidence of urolithiasis in personnel working in hot climatic conditions, as engine rooms personnel and cooks. Also seamen, who have served in areas where tropical weather conditions preveaïed had a higher stone incidence. In accordance, Prince and Scardino (1960) in a statistical analyses of urolithiasis in the south eastern United States found that the peak incidence occurred in July, August and September. Elliott (1975) concluded that peak incidence occurred during periods of above average temperature.

It seems that hot climate by increasing perspiration leads to hyperconcentration and acidity of urine which contributes to stone formation. The onset of symptoms beginning within few months after being exposed to hot climate (Pierce and Bloom, 1945).

3- Water intake

In a study by Frank et al. (1959) low urinary output was increminated as regard increased risk of stone formation. This was related to the drinking habits of the people living in Israel. European immigrants had the lowest output and highest stone incidence as water intake was low inspite of change of climate. Compared to this, native born Israelies had a relatively higher urinary output and lower stone incidence.

In accordance, Blacklock (1969) by increasing urinary output in navy personnels servicing in temperate zones was able to decrease the incidence of urolithiasis in them.

The mineral content and the state of water may have a certain effect on lithiasis. Mates (1969) found that a high content of magnesium and iron and a high total hardness of drinking water may have a protective effect against urinary calculi.

4- Diet

There is no doubt that unsuitable food makes for a shortage of protective substances in urine or leads to an increased urinary excretion of substances that may help stone formation.

Andersen (1969-1973) found that in developed countries, there appears to be a parallelism between overall incidence of upper urinary stones and a rise in the standard of living. Changes of diet structures or habit and other concomitants of modern civilization may be of major importance. Diet rich in animal proteins and fat and a lower carbohydrate consumption have been implicated.