Renal Tract Stone
Metabolic Basis and Clinical Practice

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Renal Tract Stone

Metabolic Basis and Clinical Practice

Professor Birdwell Finlayson, MD PhD

In Birdwell Finlayson one encountered an uncommon amalgam of outstanding talents: a symmetry between his attributes as surgeon, scientist, mathematician and teacher coupled with perception, ingenuity, vision and rationality. Birdwell's contribution to metabolic stone disease is without parallel and his sudden, tragic and untimely death in July 1988 has robbed us of the doyen of stone research. It is in recognition of the great regard in which he was held, both as a physician and as a man, and the enormous influence he has had on the subject matter of this book, that we dedicate it to his memory.

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Preface

The 1980's must surely be regarded as one of the most remarkable decades in the history of medicine, for it was the period that witnessed an astonishing change in the whole concept of surgical practice. In 10 years conventional open surgery for the removal of stones was dramatically replaced by percutaneous techniques, and soon superseded by the almost totally nontraumatic extracorporeal shockwave lithotripsy (ESWL). This method, apart from external beam radiotherapy, is probably the first instance that an hitherto totally surgical situation has been managed without invasive assault on the body of the patient.

Thus, a surgical philosophy of minimal invasiveness pioneered by urologists for the treatment of stones, is now being espoused by surgeons dealing with a variety of pathological conditions affecting other abdominal viscera, with the use of ever more innovative and daring techniques and with the help of remarkable advances in imaging.

The successful treatment of more than 500 000 patients worldwide by ESWL and almost double that number by percutaneous nephrolithotomy since its introduction in 1980, has firmly established these techniques in the treatment of renal calculous disease. The next few years will finally define the relative roles of ESWL and percutaneous nephrolithotomy in the treatment of stones as complementary and not competitive. The most gratifying feature of these procedures is the minimal physical disturbance that patients have experienced from their treatment, the most enthusiastic being those who had previously experienced the trauma of open renal surgery. The reduction in invasiveness and its attendant pain and discomfort have led to an enormous reduction in the time spent in hospital and in the convalescent period. Thus the social outcome is far superior to that consequent upon conventional surgery.

Renal stone disease is an enlarging problem associated with affluence and an increasingly sedentary mode of life. The slow adoption of a healthy nutritional policy results from contradictory statements and paradoxical emphasis by Western governments for both social and economic reasons and leads one to conclude that it is highly unlikely that prevailing rates of stone disease will show any decline in the forseeable future. Rather more likely is it that the present commercial ethos of 'fast', 'take-away' and 'junk' food will result in a much greater incidence of the disease. No matter how innocuous the 'surgical' treatment of stones may have become, the patient who has suffered an agonizing bout of ureteric colic wants to know whether he or she is likely to form another stone and if it can be prevented from ever occurring again. Despite the startling surgical developments in the treatment of stone disease, physicians, biochemists, physiologists and scientific researchers in other disciplines interested in the diverse aspects of urolithiasis have not been idle in their quest for an understanding of the biochemical and metabolic abnormalities associated with stone formation. Within the past 10 years there has been a considerable increase of our knowledge in this field. Much has been achieved by developments and refinements in analytical techniques of stone structure and biological fluids. The development of micropuncture/microperfusion techniques for the electrical and chemical localization and quantitation of renal tubular transport mechanisms,

has given us greater insight into the renal handling of ion homeostasis and its disturbance in urolithiasis.

The purpose of this book was to achieve a synthesis by inviting basic scientists and clinicians who are distinguished experts in the many and varied aspects of urolithiasis to authoritatively review the physiology, biochemistry, pharmacology, clinical pathophysiology and the medical and surgical aspects of stone disease. We hope that within a single volume the state of the art and the scientific achievements of the past decade in this burgeoning field of activity have been recorded. We make no apology for beginning this book with a chapter on the history of stone disease which is inextricably the history of surgery. As Osler remarked, 'We sometimes risk losing a sense of continuity, indeed, we are even impatient of those who would recall the past, impatient as we are of everything save the present with its prospects and the future with its possibilities'. With a multiauthor text of such complexity it seemed unavoidable that there would be areas of overlap and the danger of repetition. Although in some respects this would appear to be so, in essence each of the authors has brought to their subject a distinctive understanding and perspective which has, we feel, helped to enhance the quantum of knowledge and removes any bias.

We are deeply indebted to the authors of this book for the excellence of their contributions and for their time, effort and loyal cooperation throughout the preparation of the work which we hope will provide a fundamental source of reference for all who are interested in the subject Renal Tract Stone.

London and Glasgow, 1990 J. E. A. W.
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Contents

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SECTION I

General aspects

1. The history of urinary lithiasis and its treatment

Ian L. Goldman Martin I. Resnick A. Colin Buck

EGYPT

Archaeological excavations of palaeolithic Egypt clearly reveal that ancient man was afflicted with urinary stone disease. One of the earliest examples of a urinary calculus was discovered by Sir Grafton Elliot Smith in 1901 among the pelvic bones of a young man from a predynastic (circa 7000–3100 BC) tomb at El Amrah near Abydus in Upper Egypt. The stone was described as yellow in colour with a nucleus of uric acid and concentric laminations of calcium oxalate and ammonium magnesium phosphate (Fig. 1.1) (Shattock 1905). Three further stones, probably from the bladder, were found in a prehistoric skeleton excavated by Sir William Flinders Petrie (1923). On analysis they were found to consist of mixed phosphates and uric acid indicating their infective aetiology. A large vesical calculus that measured 6.5 cm in diameter was found in the nostril of a priest of Amen of the twenty-first dynasty (circa 1100–950 BC), where it had been placed by the embalmers; this stone too had a uric acid nucleus surrounded by phosphates (Elliot Smith 1901). Four renal calculi were found in a body from a second dynasty tomb (circa 3000 BC) at Maja-el-Dier. The soft tissues had disappeared but the stones lay opposite the second lumbar vertebra and were probably renal as the largest of these, measuring 1.6 cm in diameter, was found to be an oxalate stone (Brothwell 1967).

Fig. 1.1 Prehistoric vesical calculus (from Shattock 1905).

The remains of some 30 000 mummies have so far been examined, but from this large number only a few examples of urinary calculi have been discovered. After his discovery of the youth with the vesical calculus, Elliot Smith wrote: 'although I have been constantly on the look-out for other examples ever since then I have never seen another case, although close upon 10 000 bodies must have been examined either by Dr. Wood Jones or myself in Nubia and Egypt. I have seen two cases of renal calculi both in Ancient Empire graves in Egypt and one case of gall stones (in the mummy of the New Empire)'. Stones could, of course, have been missed by careless or ignorant excavation, but hardly by these two renowned anatomists on the 'look-out' for them. Given the particularly favourable burial conditions throughout Egypt generally and the fact that eviscerated organs were traditionally preserved in special jars, it is reasonable to assume that calculi would certainly have been identified in most cases had they occurred. No mention of stone is made in any of the four medical papyri. Their rarity in ancient Egypt is indeed

surprising as there is a much higher incidence of bladder calculi in Egypt today. However, urinary lithiasis in present-day Egypt is predominantly a disease of the poorer classes and similar conditions may have existed in ancient Egypt. Did stone disease then occur only in the hoi polloi who were seldom, if ever, mummified?

By contrast, the relatively common occurrence of urinary calculi discovered by Sir Henry Wellcome (Addison 1949), when, over several seasons he excavated the site of Jebel Moya in the Sudan, deserves special mention. A sample from the 2883 graves located, dating from the first millennium BC, was studied by Mukherjee et al (1955). Of the 1500 skeletons examined, 32 (2.1%) contained urinary calculi. This incidence contrasts so markedly with the findings in early Egypt as to suggest a mild endemicity in the Jebel Moyan population. In most cases only one stone was present — or was identified and retained in each individual. Most of the calculi were oval or round and ranged from 18 mm to 61 mm in diameter. In 28 cases an age separation was possible which showed that 27 were adults and only one was a child (about 7 years old). However, separation into males and females was not possible.

The Jebel Moyan stones were broken to reveal their interior structure and in no case (as indeed with the ancient Egyptian calculi) were parasitic ova discovered. This again is curious as there is literary evidence for the prevalence of schistosomiasis from the descriptions of 'AAA' disease and the haematuria mentioned in the Papyrus Ebers (Hoeppli 1959). Objective proof of the presence of the parasite in Egypt was obtained by Ruffer (1910) when he was able to demonstrate the calcified ova of *Schistosoma haematobium* in the kidneys of two mummies of the twentieth dynasty (circa 1200–1100 BC). Shattock (1905), however, had specifically searched for the ova in vesical calculi but failed to find any.

Prosper Alpinus, an Italian physician of the sixteenth century, witnessed a widely employed ancient Egyptian practice that consisted of distending the urethra by blowing into it through a tube and urging the descent of the stone by pressure from the fingers introduced into the rectum. There is no evidence that lithotomy was practised in ancient Egypt. Indeed, the impression is given that surgical treatment was a hallowed tradition only, described but never practised. Certainly Egyptian mummies do not bear the scars of surgical operations (apart from circumcision) and the whole tradition of Egyptian thought tended towards preservation of the body from injury, both in the living and the dead (Thompson Rowling 1967).

MESOPOTAMIA

In the fertile alluvial basin between the Tigris and Euphrates rivers arose one of the earliest human civilizations dating back to before the third millennium BC. Amongst the rich stores of medical knowledge preserved in the cuneiform tabloids of the Mesopotamians, urolithiasis is often mentioned and a distinction is made between hard and soluble stones together with their concomitant therapies (Thompson 1934).

HEBREW MEDICINE

Accounts of medicine and hygiene are to be found in the Talmud, a collection of Jewish laws and traditions consisting of the Misneh and Ghemara (c. 400–500 AD). Much therein is written on the urinary tract. Vesical calculi were treated medically but there is no mention of lithotomy. Early Talmudic writings describe a formula for regulating the urine of patients with stones and one such prescription reads: 'When a stone forms in the bladder and obstructs the urine, ingest three drops of extract of pitch, three extracts of leek and three of pure wine' (Rabinowitz 1880).

THE MIDDLE EAST — BABYLON, PERSIA AND TURKEY

Little is known of the medicine practised in Babylon. However, from recent excavations in this region it would again seem that few were affected by urinary lithiasis (Wilson 1955). Ancient cuneiform writings tell of the empiric treatment of renal and ureteric colic with a decoction of *Ammi visnaga* seeds.

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