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SPONTANEOUS DISSOLUTION OF RENAL CALCULI-A MYTH OR REALITY

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ABSTRACT Urolethiasis has been of interest to mankind from many centuries. Many theories has been postulated for biochemical process of stone formation. Spontaneous dissolution of stones has been known and rarely reported. We have found evidence of spontaneous dissolution of urinary caluculi in our ultra structural study and have put analogy with sedimentary rocks of sea which are also known to have such ultra structural phenomenon.

KEYWORDS : Calcium Oxalate, Kidney Stones, Spontaneous Dissolution

BACKGROUND

Urolithiasis is global phenomenon. Mankind, since long, have tried to understand the process of calculogenesis. Scientists over centuries had also tried to find the 'wonder therapy' for dissolution of urinary calculi.Though, in calculogenesis, many hypothesis has been postulated and well established, we are still not able to prevent recurrence of calculi in large number of patients due to its complex nature and poor understanding of process of calculogenesis.

AIMS AND OBJECTIVES

- Many factors are known to lead to stone formation but whether dissolution factors are also operating in the internal milieu of crystal aggregates ,is not well known
- Supersaturation/crystallization','Matrix nucleation', 'Inh ibitor absence' and 'Epitaxy' are well established theories to explain the process but none of these theories fully explain the phenomenon and perhaps many more factors are operating, hitherto, not described till now.
- We have tried to find an analogy of sedimentary rock formation in the sea with urinary stones where evidences of spontaneous dissolution like 'pitting', 'weathering' and 'erosions' are seen many times along with well known formation phenomenon

MATERIAL AND METHODS

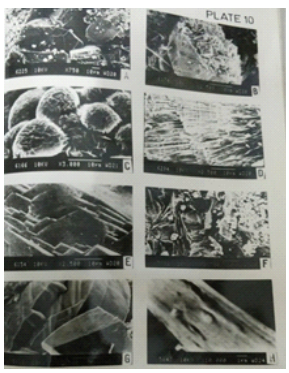
A scanning electron microscopic (Jeol 840) study was carried out from 30 upper and lower urinary tract calculi removed by surgery, in department of Urology,IMS,BHU,Varanasi.

Ultrastructure was observed using scanning electron microscopy to study the aggregation phenomenon of crystal sediments and phenomenon of weathering or dissolution of crystals X-ray diffraction analysis was also done in same calculi to know the chemical compound composition.

Study performed also in collaboration with department of Geology & Metallurgy, Banaras Hindu University , Varanasi, India.

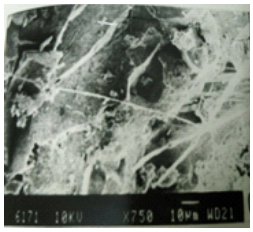
OBSERVATIONS

- Pure stone comprised 73.33 % of total number
- Among pure stones calcium oxalate monohydrate accounted for 60%, dihydrate 10% and struvite3.33%
- In Ultrastructural study in SEM many geological pheno menon were observed with their potential therapeutic applicability at magnification of 750x to 2500x
- Stone appeared in well crystalline or poorly crystalline or semi crystalline form.
- Crystals were euhedral, subhedral or anhedral
- The deposition phenomenon observed were 'crystal complexing', 'syntaxy', 'epitaxy'
- Simultaneous many dissolution phenomenon like 'etch ing', 'erosion 'or 'weathering ' were observed which were akin to sedimentary rocks formation in the deep sea
- Our SEM study shows the evidence of 'etching,' 'erosion', or dissolution of calculi studied.
- Etching was demonstrated in crystals of pure oxalate calculi as well as pure phosphate calculi
- Dissolution like weathering in sedimentary rocks is seen in 11 of 22 calculi of pure oxalates,2 of 2 calculi of mixed oxalates and all calculi of mixed phosphates

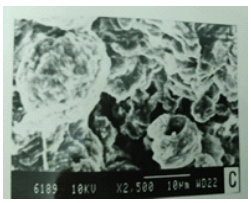


Ultrastructural Evidences of stone in formation phase with well developed crystals

EVIDENCES OF SPONTANEOUS DISSOLUTION:

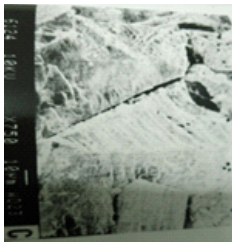


Dissolution (Weathering) in face of a platy crystal



Dissolution (weathering) of a large crystal

GEOLOGICAL PHENOMENON OF DISSOLUTION:

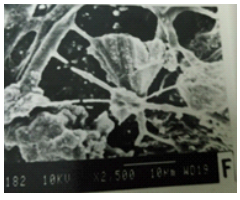


Etching and fracture on crystal

Fracture on face of a large crystal

EVIDENCES OF SPONTANEOUS DISSOLUTION:

Large coffin lid crystal in dissolution phase



Crystal plate in dissolution phase

DISCUSSION

DOES IT WORK LIKE SEDIMENTARY ROCKS:

- It is well known in mineral-logy that "minerals are in active equilibrium with their surroundings only in the environ ment in which they form(law of mineral instability, Keller1989)
- In ambient ionic atmosphere of human kidney, the urinary calculi will also be in meta stable condition in respect to its pore water i.e. urine in interstics of calculi and pore water leading to either deposition of precipitates or dissolution depending on type of reactions taking place

GEOLOGICAL PHENONMENON SEEN IN CALCULUS ULTR ASRUCTURE LIKE SEDIMENTARY ROCKS:

- Slow partial dissolution may results in itch pits
- Corrosion or weathering may results from more rapid transport of minerals
- It appears that calculus in the milieu interior involves itself in dynamic chemical process whether leading to deposition or erosion time to time

CRYSTAL FORMATION OR DISSOLUTION:

- These phenomenon are also influenced by surface free energy property of the crystal(hurst1981).
- Euhedral crystal faces possess low surface energy and are less likely to undergo surface corrosion or dissolution while high index crystal (subhedral or anhedral) are more likely to be influenced by dissolution phenomenon

WEATHERING IN SEDIMENTARY ROCKS:

"**Weathering** and erosion. **Weathering** is the process where rock is dissolved, worn away or broken down into smaller and smaller pieces. There are mechanical, chemical and organic **weathering** processes. ... Erosion

ANALOGY WITH SEDIMENTARY ROCKS:

- "Diagenesis" is sum of those process by which originally sedimentary deposits attempt to reach equilibrium with their environment
- Though, owing to influence of organic substances, matrix and bacteria, process of diagenesis may be arrested or modified, if suitably applied, this process may be potentially manipulated to "weather" or dissolve a human calculi.

CONCLUSION

- A compatible analogy can be drawn between human rocks and sedimentary rocks formation in nature
- Ultra structural observations of 'weathering',' pitting', 'erosion' seen in human calculi indicate spontaneous dissolution phenomenon taking place in human body like sedimentary rocks is a reality and not a myth.
- We propose sedimentary rock analogy in human body as we have so many evidences of same type of bodily rock formation in human body.
- Further well designed studies are required to look into this fascinating aspects of calculogenesis

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