Quantitative Differences in the Calcium Deposition on the Surface of Metal or Plastic Intrauterine Contraceptive Rings in the Hen Uterus

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Abstract

In previous papers, we have reported marked deposition of calcium salts, mostly calcium carbonate, on the surface of contraceptive devices following their application into human uteri (Chiu et al 1970, Yang et al 1971).

For further experimental comparison of calcium salts deposition on intrauterine contraceptive rings, pairs of two different rings were parallel linked with silk line, then the pair was inserted into the uterus of a hen soon after it had started laying eggs. Immediately after its expulsion, the pair was photographed and chemically analysed for the amount of calcium carbonate on its surface.

Seven experiments using a pair of one plastic ring and one stainless steel ring demonstrated that there was no apparent difference in deposition on the surface of rings. Quantitative analysis of the calcium carbonate also supported this finding.

On the other hand, nine experiments using a pair of one plastic ring and one stainless steel ring coated with rhodium, demonstrated that deposition on the plastic rings was much less than on the rhodium-coated stainless steel rings. Quantitative analysis of the calcium carbonate on their surfaces also showed 10 times greater deposition on the rhodium-coated rings.

It appears that to prevent calcium carbonate deposition on surface of the devices, the contraceptive ring should be made of either plastic or stainless steel without a coating of rhodium.

Introduction

It has been shown that following the application of intrauterine contraceptive devices, a deposition, which was chiefly composed of calcium carbonate, gradually accumulated on the surface of the devices (Yu 1968; Yang 1968; Yu and Chiu 1970; Yang and Yang 1971). On one intensely deposited contraceptive ring, an "uterine stone" was formed with the device as its nucleus, which was extremely difficult to remove (Yu 1968; Yu and Chiu 1970). Although it has been known that following the application of an intrauterine device for a period of time that the surface of the device became covered with a thin

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layer of white cells, mostly, collagen and PAS-positive substances (Hall et al, 1965; Potts and Pearson 1967), it was thought unlikely that these substances would cause calcium carbonate deposition on the surface of the device. It is very possible that the nature of device may greatly affect the amount of deposition on the device. It is the purpose of the present study to investigate further the calcium carbonate deposition on different kinds of intrauterine contraceptive rings following variable periods of application in the hen uterus.

Materials and Methods

Mature hens (2 to 3 months old) of the white Leghorn strain were kept in isolated cages following their purchase from a local dealer. After the hens showed daily ability to lay one egg per day for 5 consecutive days, they were used for this experiment. Within 3 hours after their last delivery of eggs, these hens were inserted with a pair of two different intrauterine contraceptive rings through the cloaca and the orifice of uterus to the ampullor portion of the uterus, approximately 3 to 5 cm from the orifice. The pair of two different rings were tied together in 3 knots with a silk line. For comparison, the pair was usually composed of a polyethylene plastic ring and a stainless steel ring, or polyethylene plastic ring and a rhodium-coated stainless steel ring. The total surface area of the two different rings was quite similar, as shown by calculation on their diameters and lengths. Immediately after the application of the devices, the hens were subcutaneously injected with 40 mg chloropromazine for sedation, so that the ring would not be easily evacuated. Thereafter, the hens were watched for the time of the expulsion of the devices. Following recovery of the expulsed rings, the pair of rings were separated from each other. The whitish deposition on the surface of rings was examined and photographed under a stereomicroscope, and then carefully scratched off into a 10% hydrochloric acid solution, and slightly heated to completely dissolve the calcium salts. The calcium content, as calcium carbonate in the solution, was titrated according to the method of Betz and Noll (1950).

Results and Discussion

The accumulation of calcium deposition on the surface of the rings increased in proportion to the length of time the devices remained in the uterus. However the rate of increase in the calcium carbonate deposition appeared to be much higher on the rhodium-coated stainless steel ring than on the regular stainless steel or plastic rings. Seven pairs of stainless steel rings and polyethylene plastic rings were applied from half an hour to 21 hours in the uterus of hens for a comparative study. No marked difference was found in the amount of deposition on each kind of rings either by microscopical examination or by chemical titration (Fig. 1 and Plate 1). By contrast, when nine pairs of rhodium-coated stainless steel rings and polyethylene plastic rings had been applied for from 2 to 21 hours in the hen uterus, a significant differ-

ence in the amount of deposition on each ring was seen. At any duration of time, the amount of deposition of calcium salts on the rhodium-coated ring was 10 times greater than that on the polyethylene plastic rings (Fig. 2 and Plate 2).

Although it was suggested that calcium deposition on metallic rings appeared to be less than that on plastic rings in the human uterus following the application for several years (Yang and Yang 1971), no marked difference was seen with regard to the amount of deposition on either stainless steel rings or plastic rings in the hen uterus, for a one day period in the current experiment. On the contrary, the deposition of calcium carbonate on the rhodium-coated ring appeared to be markedly higher than that on the plastic ring. Both physical and chemical properties of the rings were probably responsible for the deposition of the calcium salts on the surface, since the original character of low affinity for the attachment of calcium carbonate was dramatically altered following a coating with a thin layer of rhodium on the surface of the stainless ring. Difficulty in deposition of calcium carbonate on stainless steel may be the chief reason why the devices did not cause any deleterious effects even after their application for 30 years in the human uterus (Nelson, 1962). In addition, lower incidence in the occurence of tumor was noted by implantation of stainless steel devices than by that of plastic devices in the subcutaneous tissue of rats (Southam and Babcock, 1966). Therefore, it appears to be very clear from this study that the regular stainless steel ring is much more suitable than the rhodium coated ring as an intrauterine contraceptive device for the prevention of calcium carbonate deposition and ultimately a "uterine stone" formation.

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EXPLANATION OF PLATE 1

Four stereomicroscopical pictures of the linked plastic (left) and stainless steel (right) contraceptive rings demonstrating that calcium carbonate deposited rather equally in amount on either plastic ring or stainless steel ring 0.5, 2, 7 and 7 hours after the application of the pairs in the hen uterus respectively.

Magnification

EXPLANATION OF PLATE 2

Four stereomicroscopical pictures of the linked plastic (left) and Rhodium-coated stainless steel (right) contraceptive rings demonstrating that calcium carbonate deposited much more on the Rhodium-coated ring than on the plastic ring 3, 4, 6 or 17 hours after the application of the pairs into the hen uterus respectively.

Magnification

在母鷄子宮內的塑膠製或金屬製避妊圈上發生鈣鹽沉澱的量差異

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摘　要

在前次報告中，我們提出而在人子宮內使用中的避妊器上發生鈣鹽（特別是炭酸鈣）沉着的現象(Chiu et al. 1970, Yang et al. 1971)。

爲了比較研究在不同避妊器上發生的鈣鹽沉着量，我們把兩種不同材質的避妊圈用絲線在三處並列地結紮在一起，然後按放在剛生過卵的母雞子宮內。經過1至24小時，母雞產出避妊圈後，我們再把那成對的兩種避妊圈隔開來，用立體顯微鏡觀察，或用化學定量法測定鈣鹽的沉着量。

七對塑膠避妊圈與不銹鋼避妊圈比較的結果，在兩者表面沉着的鈣鹽並沒有顯明的差異。然而，對九對塑膠避妊圈與用Rhodium 電鍍的不銹鋼避妊圈比較的結果，在後者表面沉着的鈣鹽就比在前者表面沉着的鈣鹽多出10倍以上。

這個實驗表示，爲了避免鈣鹽的繼續沉着，宜選用材質爲塑膠或不銹鋼的子宮內避妊器。

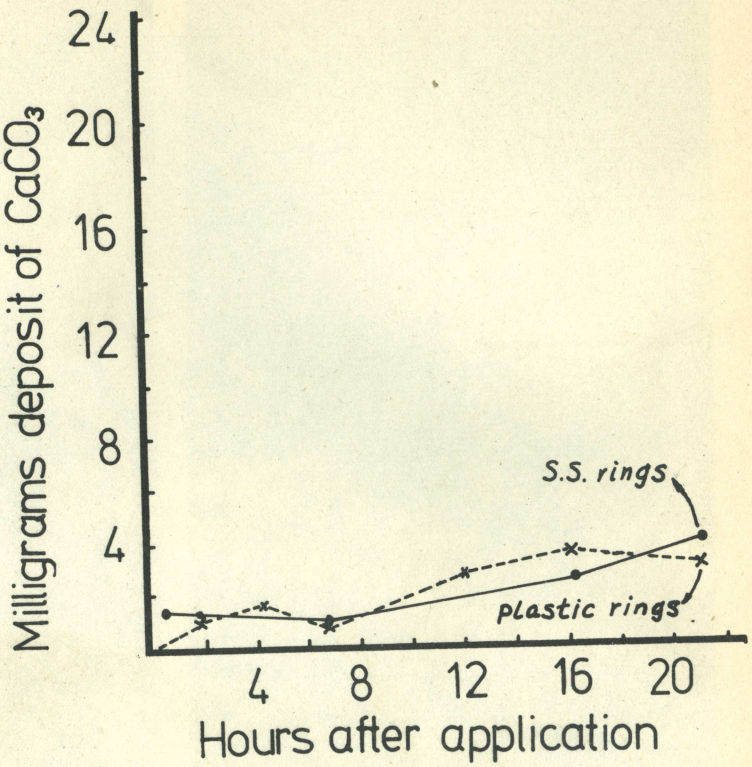


Figure 1

Quantitative difference of calcium carbonate deposition on plastic rings and stainless steel rings (pairs of two different rings were linked together for application of various duration in hen uteri).

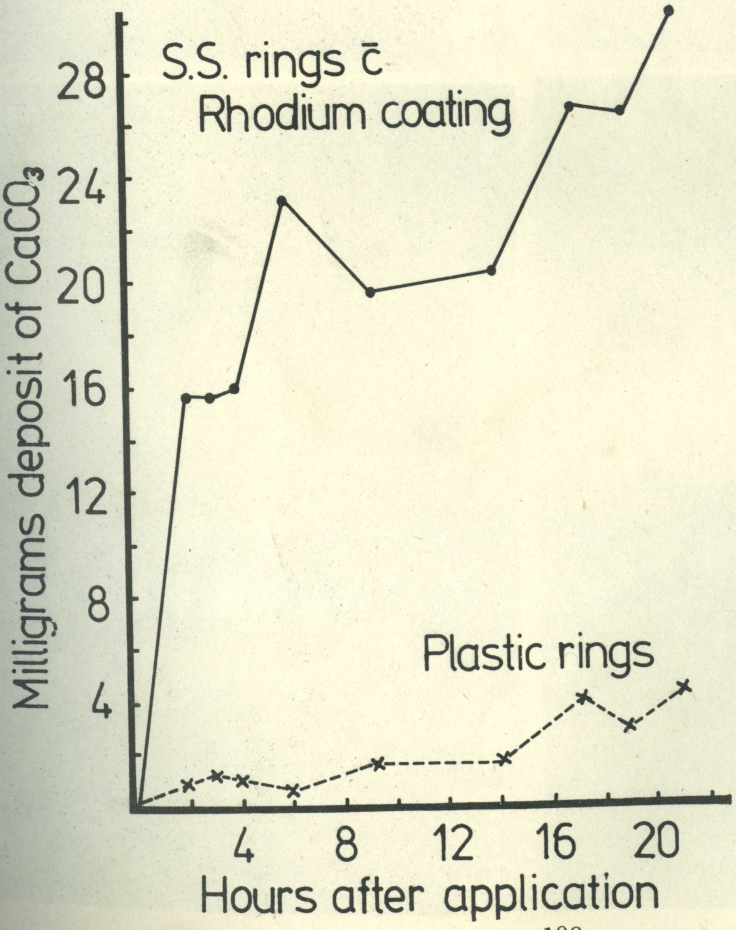
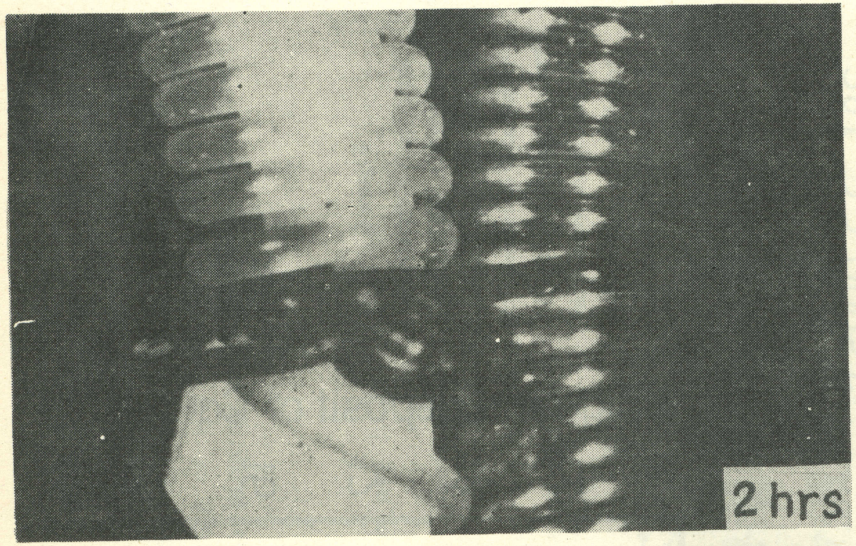
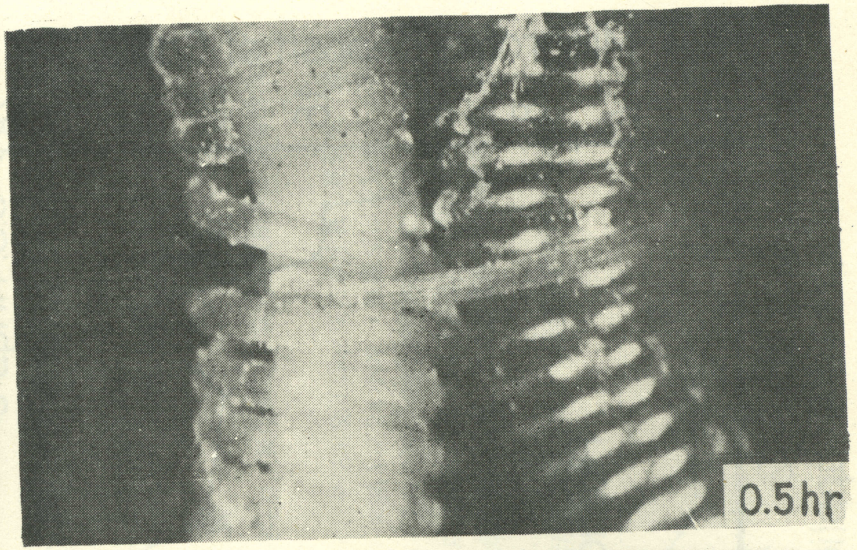
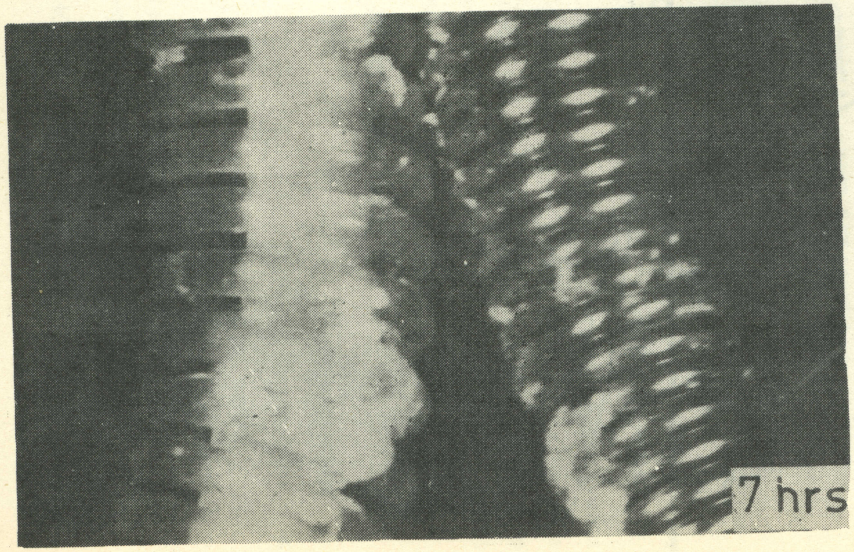


Figure 2

Quantitative difference of calcium carbonate deposition on plastic rings and rhodium-coated stainless steel rings (pairs of two different rings were linked together for application of various duration in hen uteri).







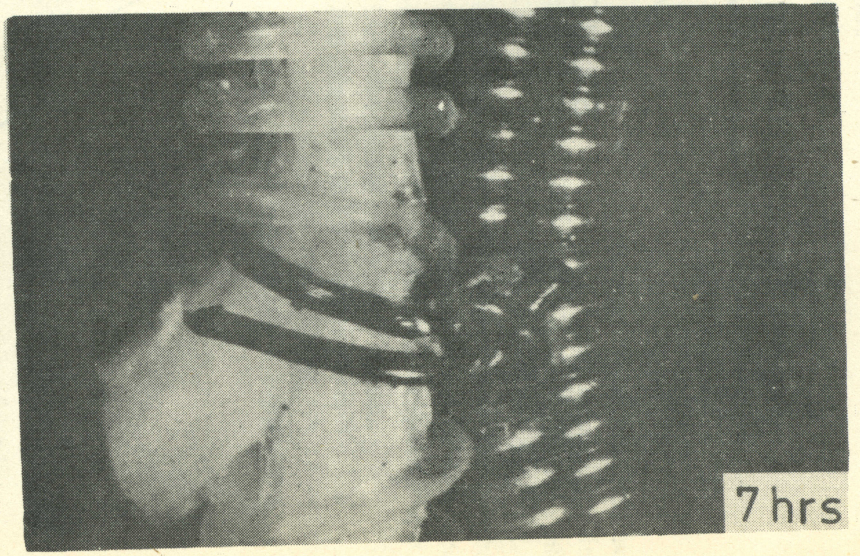
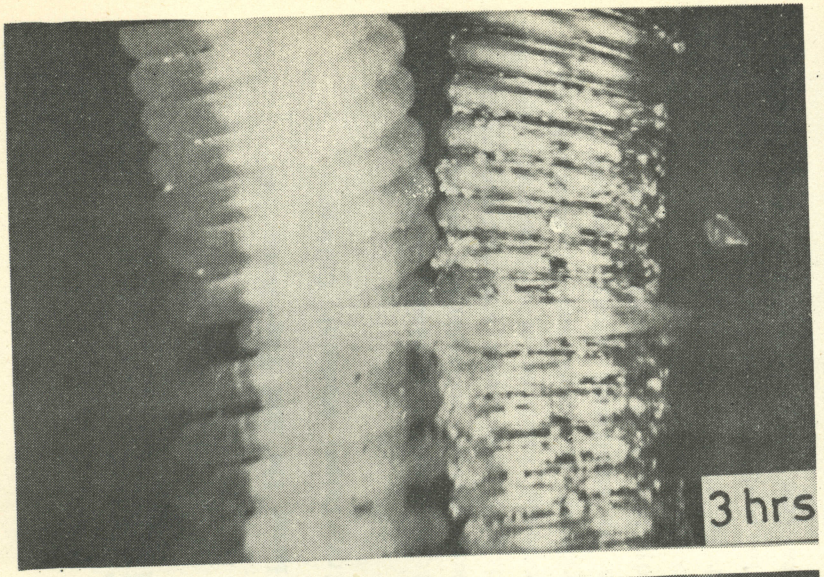
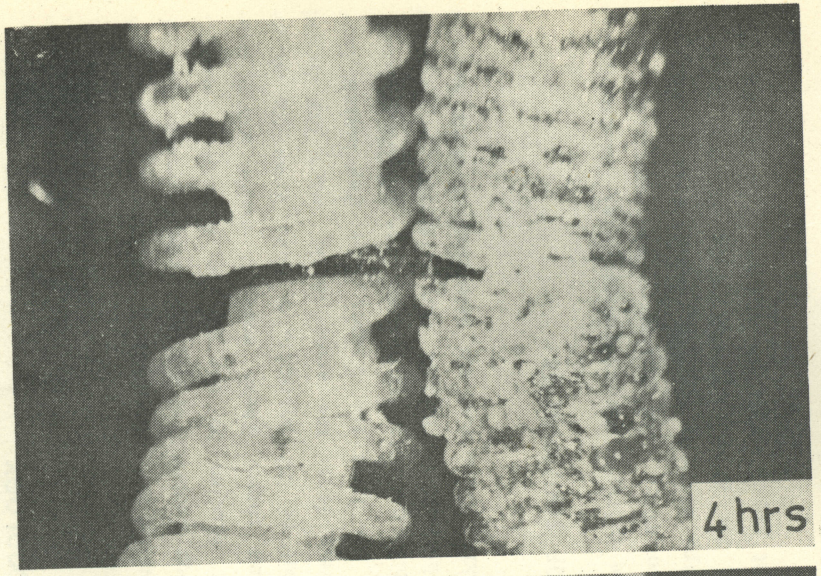
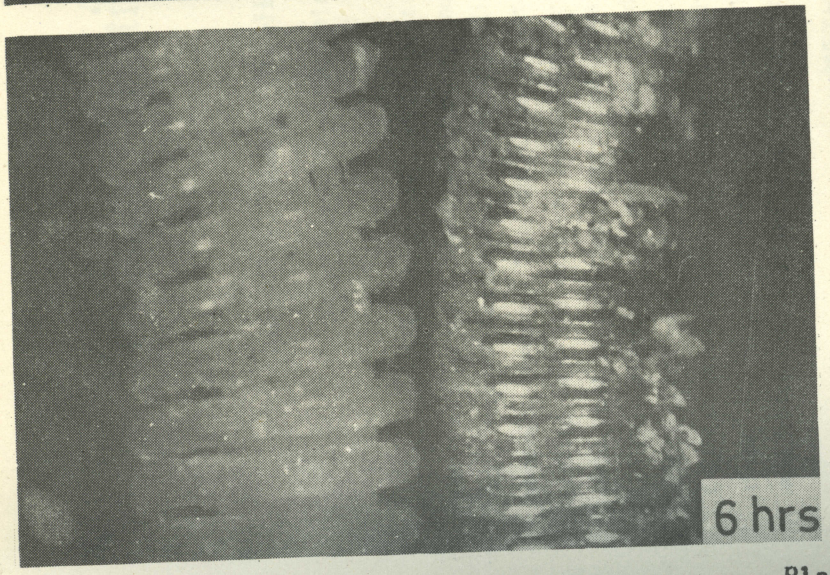


Plate 1







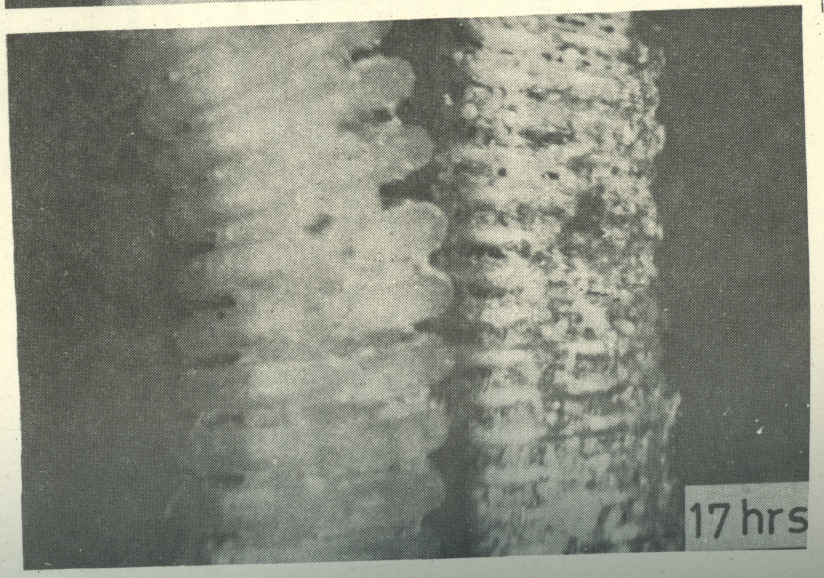


Plate 2