21. FUTURE DEVELOPMENTS IN INTRAUTERINE CONTRACEPTION

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In 1909, Dr. Richard Richter, a Polish gynecologist published his experience with the first intrauterine device, which was made of silkworm gut in the form of a ring (Richter 1909). The insertion technique was described and Dr. Richter's results are best summarized in a translation of his own words:

> After many years of testing and improving I am able to offer to my colleagues a simple, safe contraceptive. This is a silkworm gut suture which is inserted into the uterus. Irritation of the endometrium by the thread is so that the majority of women never feel it, yet it does prevent pregnancy. In some of my cases, women have used the device for almost four years. Insertion is easy... minor bleeding stops after a few days... Removal is easy as the thread can be pulled out of the uterus with a forceps. Following removal, fertility is restored.

Unfortunately, Dr. Richter's device met with scientific negativism, and it was not until 1923 that Dr. Karl Pust published his results with a similar ring made of silkworm gut (Pust 1923). Pust's device included a tail of similar material fixed to a cervical button made of glass. This button was thought to serve the function of closing the cervical os, thereby forming a mechanical barrier to the ascent of spermatozoa and bacteria.

During the late 1920s, Dr. Ernst Gräfenberg published his results with his own intrauterine rings, and presented his findings at several international conferences. Other physicians also reported favorable results with similar intrauterine rings, including Ota (Japan), Luenbach (Denmark), Manes (Germany) and Heire (England). After a series of clinical trials, Gräfenberg finally evolved his intrauterine ring composed entirely of silver coils. In 1930, among 600 women fitted with the silver ring, he reported a 1.6-percent pregnancy rate, and a four-percent expulsion rate. Gräfenberg frowned upon the use of any IUD having a connecting bridge (thread or tail) from the uterus to the vagina, because of his great fear of the increased possibilities of ascending pelvic infection.

Except for a few gynecologists, mostly in the United States and Japan, no enthusiasm existed for this method of birth control for the next 25 years.

Several developments occurring more or less simultaneously took place in the early 1960s which jointly led to the reemergence of intrauterine contraception and, more importantly, to the use of IUDs by millions of women in almost every country of the world. The favourable reports published from Israel by Oppenheimer (1959) and from Japan by Ishihama (1959) on intrauterine rings made of silkworm gut prompted others to investigate the use of modern plastics, metal and other materials manufactured or moulded into a variety of shapes and sizes. During that period, many world leaders developed an acute awareness of population growth rates, and researchers began thinking of appropriate contraceptive technology that could be used by the millions of women in need. It seemed that the establishment of national family planning programmes coupled with the promotion and use of intrauterine contraception could provide the solution to the problem of ever-increasing numbers of people. Indeed, by 1965, approximately six million women worldwide had had an IUD insertion, making this medical procedure one of the most commonly performed. Unfortunately, intrauterine contraception has not provided the mass solution because of several disturbing side effects, and a potential for adverse health situations directly or indirectly attributable to intrauterine contraception. In 1970, approximately twelve million women were using IUDs, but by 1978 estimated users had increased to only 15 million, the vast majority of them in developing countries (United States Agency for International Development, 1978). In the United States IUD use has remained more or

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less stationary for several years at a level of nine percent of all contraceptors.

Intrauterine contraception, despite its low levels of acceptance and use and the fact that it has not provided *the* answer to the world's population problems, still maintains an important role in fertility control. Certainly, the appeal of a contraceptive method that requires only one act of motivation, a simple insertion procedure, that subsequently provides years of safe protection from pregnancy, continues to be strong. No other reversible method of contraception has these excellent attributes. Accordingly, it is fully appropriate that clinicians, scientists and researchers continue to seek improvements in this wonderfully simple contraceptive technology.

I. IS IMPROVEMENT IN INTRAUTERINE CONTRACEPTION POSSIBLE?

Table 1 indicates, in an acrostic fashion, the major concerns with intrauterine contraception. These concerns exist for both nonmedicated and medicated IUDs, although certain of the concerns, for example development of neoplastic change and congenital anomalies, are more closely linked with devices medicated with such compounds as copper, other metals or steroid hormones. Each of these areas of concern will be discussed with the objective of trying to answer the question, 'Is improvement possible?'

I.A. Contraceptive effectiveness

There is no question that IUDs are potent inhibitors of intrauterine pregnancies in all animal species, including the human female. Most types of devices, in clinical situations, provide an effectiveness rate of about 1-3 pregnancies per hundred woman-years. It is remarkable that intrauterine contraceptive devices achieved this effectiveness despite the fact that the precise mechanism of action is as yet unknown.

Table 1. Areas of concern for IUDs.

I	nfection
U	nwanted effects (bleeding, pain, discharge)
D	uration of action (expulsion)
C	ontraceptive effectiveness
O	ther effects (for example anemia, perforation)
N	eoplastic change
C	ongenital anomalies
E	ctopic pregnancy
R	estoration of fertility
N	onmedical concerns (cost, manufacture, acceptability)
S	pontaneous (Septic?) abortion

Because nonmedicated IUDs exert different biological effects in different species conclusions regarding the possible mode of action in humans cannot be drawn on the basis of research in animals. What seems certain is that IUDs are effective via their local action in the uterus and that there are no systemic mechanisms in operation. These local effects include the continued presence of large numbers of macrophages and polymorphonuclear leukocytes in both the endometrium and uterine fluid; mononuclear cells, plasma cells and foreign body giant cells may also be present. It is presumed that these inflammatory response cells provide the contraceptive action of IUDs, perhaps by prevention of blastocystic implantation, or by phagocytosis of the spermatozoa or blastocyst (Morese et al. 1971). Other mechanisms have been suggested; prostaglandin-E and F levels are increased in several animal species and in humans in the presence of an IUD. The increase in prostaglandin levels may be an important factor in preventing blastocyst implantation (Chaudhuri 1971). Additionally, there are changes in various endometrial enzymes in the presence of an IUD, although none have been specifically implicated as a possible explanation for the IUD contraceptive action.

Copper-bearing IUDs elicit uterine responses similar to those of conventional IUDs, but the added copper release exerts its own effects. Copper interferes with uterine hormone receptors for estrogen and progesterone. Copper increases the fibrinolytic activity of the endometrium in rabbits. Copper ions may interfere with enzymatic activity in the endometrium, which may in turn affect blastocyst implantation (Tatum 1977). These additional effects may explain the greater contraceptive effectiveness with such devices.

Progesterone-releasing devices exert their main contraceptive effect by progestogenic changes in the endometrium resulting in endometrial repression and glandular atrophy, in addition to the changes caused by the carrier IUD. Although there is uterine adsorption of progesterone with consequent syste-