

## STERILIZATION OF THE FEMALE BY COAGULATION OF THE UTERINE CORNU

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**D**ELIBERATE sterilization of the female is neither a new nor a novel procedure. During the past few years it has been accorded unusual attention, due to the activities of eugenists, as well as legislative enactments in this country and abroad for the sterilization of criminals and mental defectives. The medical profession's chief interest in this subject, however, lies in the development of simplified methods which will sterilize, with a minimum of risk, those women whose physical and mental future may be jeopardized by pregnancy, labor and their complications.

The earliest practiced method of treating the woman whose constitutional condition precluded a normal pregnancy and labor at term was by the induction of abortion. The first allusion to this subject is credited to Actius de Amida,<sup>9</sup> who advised induced abortion, "if a woman unable to carry to term, by neglect becomes pregnant." Interference was the custom for centuries and it was not until 1819 that the first attempt to prevent pregnancy was made by Blundell,<sup>1</sup> who by a major surgical procedure ligated the fallopian tubes. Since that time, many devices for the prevention of conception have been described and used.

Arbitrarily classified, procedures for sterilization are biologic, physical or surgical.

Biologically induced sterility in the female is still in the experimental stage and although alleged successful results have been reported, there is nothing sufficiently definite or authentic in the literature to establish a precedent which would warrant the clinical application of this method.

The earliest physical agent used for sterilization was the intra-uterine application of silver nitrate to the tubal openings by Froriep<sup>8</sup> in 1850, with the hope of sealing them by cauterization. Kocks<sup>6</sup> constructed a galvanocautery uterine sound in 1878 for the same purpose. In 1916, Dickinson<sup>3</sup> cauterized the intra-uterine tubal openings with a nasal tip cautery. Later, he modified his technic to include the use of a hysteroscope,<sup>4</sup> and Nishizaki<sup>16</sup> reported electrocoagulation in 1929-1930. Mikulicz-Radicki<sup>13</sup> coagulated the tubal openings experimentally

in rabbits. Sneguireff<sup>14</sup> attempted to destroy the uterine mucosa with steam, and Ploss<sup>17</sup> reported an Asiatic custom of voluntary induction of retroflexion of the uterus. X-ray and radium were utilized to produce temporary sterility with varying success by Vera, Faber, Reifferscheid, Gauss, Seitz, Wintz, Bagg, A Howard, Weiss, Robinson and others.<sup>2</sup>

Among the surgical measures, tubal operations predominate, although operations on the vagina, uterus and ovaries have been advocated. Some were novel, others ingenious and complicated, but none was uniformly successful in producing permanent sterility in women. Operations on the tubes consist of ligation, crushing with ligation, tubal resection, burying the terminal end of the tube or total excision. All subsequent methods are merely refinements of technic or modifications of the original operative procedures. That they do not eventuate in uniformly satisfactory results is indicated by the many failures reported in the literature. The question of which operation is best remains unanswered at the present time, because pregnancy has occurred in spite of the special technic employed in each method. Apparently nothing short of panhysterectomy can be depended upon to accomplish permanent sterility by surgical measures. This may seem exaggerated, but both McMillan and Dunn<sup>12</sup> and Liepmann<sup>11</sup> have reported abdominal pregnancy following supravaginal hysterectomy. Total removal of the tubes and ovaries has not always been successful. Gordon<sup>2</sup> reported pregnancy two years after bilateral salpingo-oöphorectomy; Bainbridge,<sup>2</sup> pregnancy one-half year after operation; and Lasch<sup>10</sup> and Werhatzky,<sup>18</sup> normal pregnancy following bilateral tubal extirpation.

Indications for therapeutic sterilization are always definite. Certain complicating factors are trivial, responding well to therapeutic measures, and allowing continuation of a pregnancy and parturition with only slight risk. On the other hand, others initiate serious and grave symptoms, which may develop at almost any time after conception and jeopardize the patient's life. Tuberculosis, in its varied manifestations, advanced renal lesions, organic cardiovascular involvements, established diabetes mellitus, specific neurologic diseases, toxic goiter, and malignant disease are some of the conditions which make pregnancy and subsequent parturition particularly dangerous.

Many contraceptive methods have been advocated, but these prophylactic measures often fail, none is certain, and the patient using them is frequently anxious and apprehensive. Medicinal agents are seldom effective and eventually the pregnancy must be interrupted by surgical intervention. The constitutional impairment may increase the opera-

tive risk and render the patient more susceptible to postoperative complications. If, on physical examination, childbearing is deemed contraindicated, contraceptive measures are less harmful than either repeated abortions or sterilization by abdominal section.

Surgical sterilization in patients with organic disease is attended by increased operative hazards in proportion to the gravity of the complicating condition, and operation does not guarantee permanent success. As a contribution to the solution of the problems under discussion, I have devised an instrument and developed an intra-uterine technic, whereby the fallopian tubes are sealed at their intra-uterine openings by coagulation with the high frequency current under direct vision with the fluoroscope. It is a simple office procedure, free from unpleasant reactions, and does not interrupt the patient's daily life.

The uterine cavity, flattened antero-posteriorly, is triangular, with the base at the fundus, its lateral angles funicular and continuous with the intramural portion of the fallopian tubes. The apex of the triangle is at the isthmus uteri.

It is essential to bear in mind that the average measurements of the uterus in nullipara are:

Length from fundus to the external os.....	7- 8 cm.
Width at the fundus between openings of the oviducts.....	4- 6 cm.
Length of body and fundus.....	4.5-5.5 cm.
Width between anterior and posterior walls.....	2.5 cm.
Thickness of uterine wall.....	1.5- 2 cm.
Length of cervix uteri.....	2.5 cm.

In a multipara, these measurements are usually increased by about 1 cm., particularly the width of the body of the uterus.

The intra-uterine electrode conforms to the configuration of the uterus and is calibrated according to these average measurements. It can be introduced through the cervical canal to either cornu without pain or trauma. The tip enters the lumen of the fallopian tube and makes intimate contact with the uterine mucous membrane as well as that of the tube. The original instrument for sterilization has been improved since I first described it in 1934. It consists of five parts:

1. A hollow rigid tube, insulated throughout its lumen and resembling a uterine sound in shape and appearance. Its distal third is curved to conform to the normal contour of the uterine cavity and is calibrated in inches.

2. A metal sleeve, 1.5 inches long, one-half inch in diameter, on the proximal end of this tube. A small fixed knob on its distal end is placed to indicate the position of the tip when the instrument is in the uterine cavity.

3. A hard rubber insulated handle, 3 inches long, one-half inch in



diameter. Its distal inch fits into the proximal end of the metal sleeve. To the other end of this handle, a terminal provides for the attachment of a conducting wire from the high frequency apparatus.

4. A semi-flexible insulated wire passes throughout the entire length

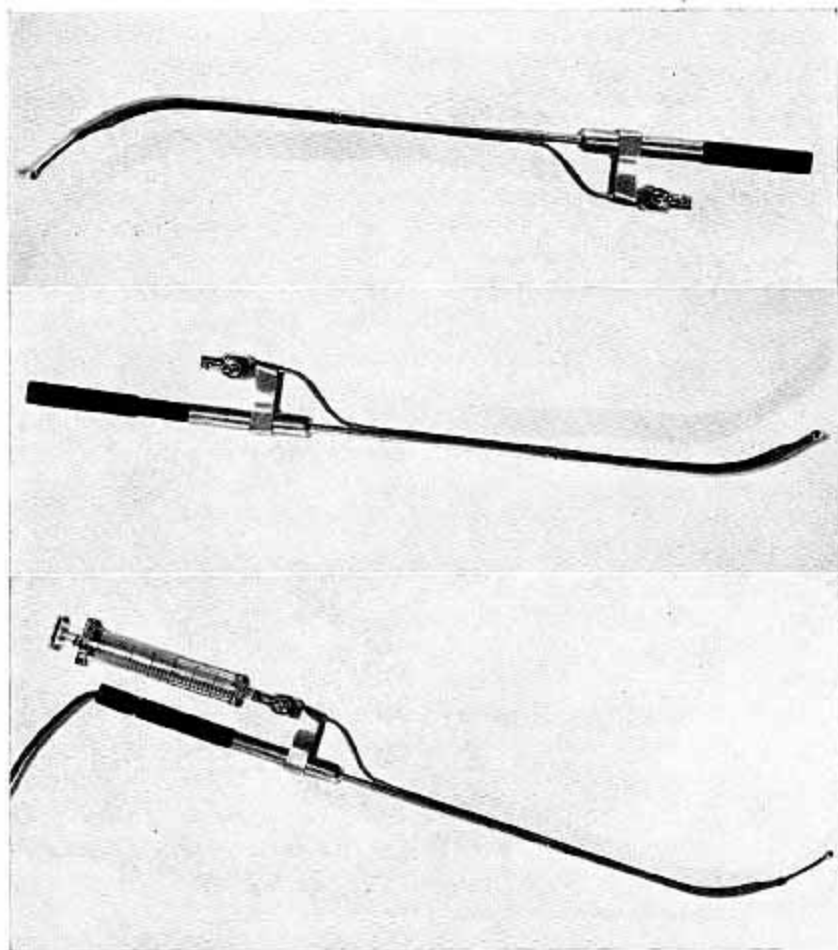


Fig. 1. A, Sterilization instrument "open." B, Sterilization instrument "closed." C, Sterilization instrument complete with Luer syringe attached.

of the metal tube, connecting the insulated rubber handle to a small acorn-shaped metal tip which fits into the funnel-shaped opening of the uterine end of the fallopian tube. By advancing the insulated handle into the metal sleeve, the acorn-shaped tip is projected about one inch beyond the distal end of the instrument. For convenience,

this position is termed "open" (Fig. 1a). When the tip rests snugly against the end of the instrument, it is regarded as "closed" (Fig. 1b).

5. A metal tube of very small caliber is attached to and is parallel to the upper surface of the body of the instrument, extending one-fourth inch from the distal termination of the instrument to three-fourths inch from the handle. Its proximal end is fitted with an adaptor provided with a stop-cock, so that a Luer syringe can be at-

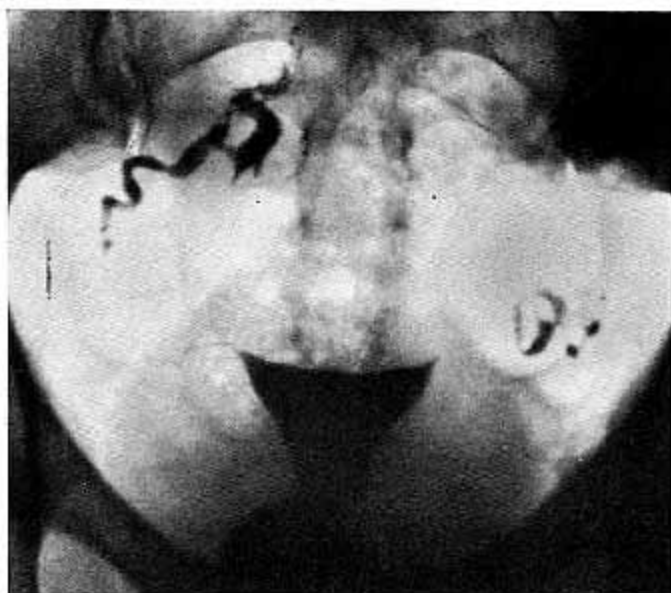


Fig. 2. Uterosalingogram taken before coagulation for sterilization.

tached for the purpose of introducing radiopaque medium into the uterine cavity for direct vision with the fluoroscope (Fig. 1c).

#### TECHNIC

A preliminary uterosalpingogram is essential because of the marked variation in size and contour of the uterine cavity in different individuals. Pathologic conditions and anatomic variations which might interfere with exact technic can be thus detected.

The patient is placed in the lithotomy position on a fluoroscopic table, and vulva, vagina and cervix are thoroughly cleansed and sterilized. The instrument is sterilized by immersion in a 1:1000 solution of oxy-cyanide of mercury. The "closed" instrument, held like a pencil with the curve upward, is passed into the uterine cavity until the tip reaches

the fundus. It is then withdrawn about one-half inch and rotated so that the tip points toward the opening of the uterine oviduct to be sealed. A Luer syringe containing radiopaque medium is attached to the adaptor and 2 to 4 c.c. of the solution gently injected. Under fluoroscopic visualization, the uterine cornu and the funicular opening of the fallopian tube will be distinctly outlined. Still under direct vision, the instrument is manipulated and advanced so that the acorn tip is en-

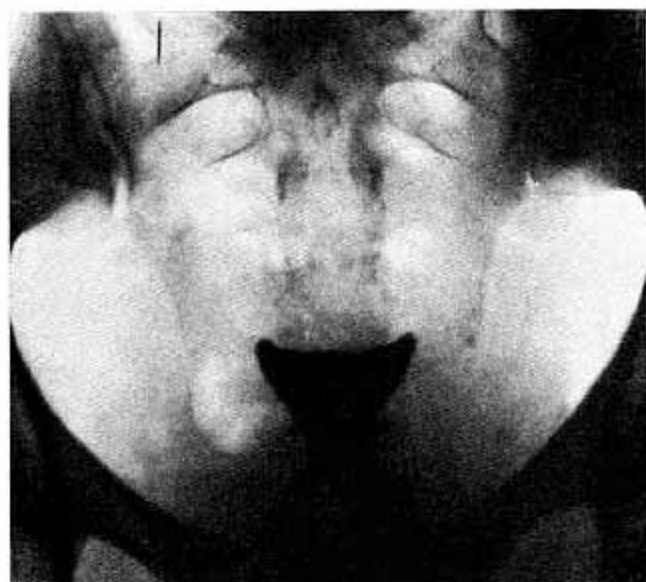


Fig. 3. Uterosalphingogram; same case as Figure 2, taken after coagulation of uterine cornu. Note appearance of apex of funnel.

gaged in the opening of the tube. The handle is pushed into the metal sleeve, and the instrument thereby "opened" by projecting the tip beyond the end of the metal tube. The flexibility of the insulated wire permits the acorn tip to find its way snugly into the lumen of the fallopian tube. The small knob on the metal sleeve indicates the direction in which the tip points, and facilitates visualized manipulation of the instrument under the fluoroscope. The instrument is held firmly in place, the radiopaque medium gently aspirated with the Luer syringe, and the fluoroscopic switch turned off. An inactive metal electrode, approximately 6 by 6 inches, is placed on the abdomen of the patient, held firmly in place by either a sand bag or a strap, and connected to the high frequency apparatus by a conducting wire. A second conduct-

ing wire from the high frequency machine is attached to the terminal on the handle of the instrument. The foot switch of the high frequency machine is closed, and, using an interrupted current of approximately 200 to 300 milliamperes, the opening of the oviduct is coagulated for eight seconds and completely sealed. The instrument is then "closed," partly withdrawn and rotated so that its tip points to the opposite tubal opening.

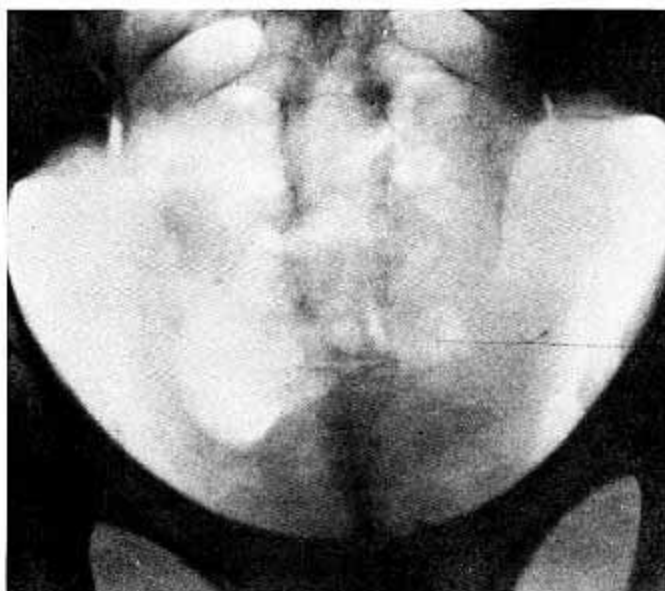


Fig. 4. Uterosalingogram; same case as Figures 2 and 3, taken twenty-four hours after Figure 3.

Under direct vision, the procedure is repeated on the other side. The instrument is then withdrawn, and a light vaginal mercurochrome gauze pack inserted.

Sterilization by this procedure is contra-indicated during a menstrual period. If the uterine cavity is distorted by submucous fibroids or by extrinsic pressure of uterine tumors, the openings of the fallopian tubes may be inaccessible. Acute or subacute pelvic inflammations, polypi, hydrosalpinx, et cetera, are obvious contra-indications.

The many failures in sterilization of the female may be attributed to the remarkable regenerative powers of the fallopian tubes. Koerner<sup>7</sup> in 1928 reported histologic studies of tubes which had been occluded by his method of temporary sterilization. These showed re-establishment of patency of the lumen, with complete regeneration of the tubal



epithelium. For this reason, any procedure limited to occlusion of the tube alone is not adequate, and should always include the adjacent uterine cornu. In my first experiments, I attempted to coagulate the uterine cornu without fluoroscopy, prior to an operation in a few patients whose pathologic condition necessitated hysterectomy. Following operation, sections were taken from the uterus, and macroscopic studies made of the effect of surgical diathermy on the utero-tubal segments.

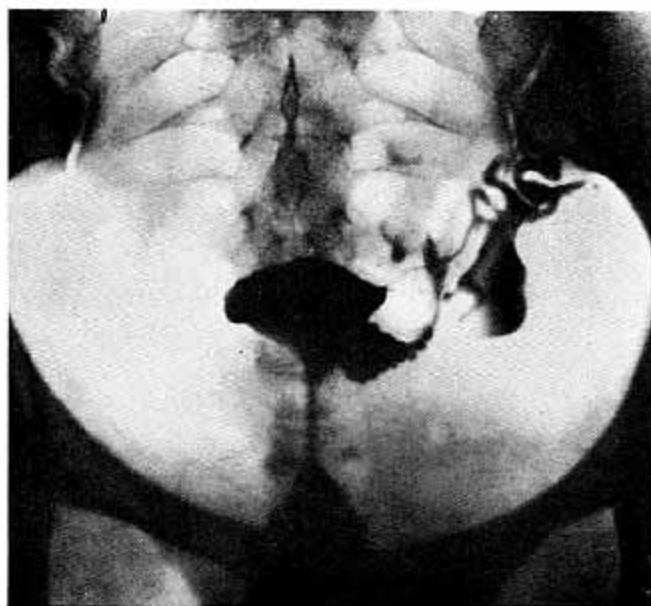


Fig. 5. Uterosalingogram; right fallopian tube closed by coagulation. Note appearance of the apex of the funnel.

The same procedure was then carried out in patients in whom therapeutic sterilization was indicated. The tubal openings were completely obliterated in the limited number of cases available, this being verified by utero-salpingography. Of those patients whom we were able to follow up, three showed complete closure on one side with restoration of patency on the other. A fourth, in whom the tubes were occluded on both sides three months after sterilization, became pregnant nine months later. One tube had re-opened, the other remaining closed.

It became evident that notwithstanding the correctly designed instrument, small specific areas could not be coagulated by a non-visualized procedure. The instrument was therefore improved. The shaft was



made flexible for easier introduction and the acorn tip enlarged for better contact, thus permitting more accurate coagulation of the tubal opening and a large area of its adjacent uterine mucosa. In the absence of a practical hysteroscope, fluoroscopy offered the best possibility for a visualized technic. With the modified instrument, radiopaque medium and the use of the fluoroscope, comparative studies were made of the interior of the uterine cavity and the lumen of the fallopian tubes on a series of cases, some of whom were beyond the childbearing period. It was clearly demonstrated that, with direct vision, the instrument could be manipulated within the uterine cavity and the tip introduced to the desired distance into the apex of the funnel with the utmost accuracy. The improved technic was first carried out experimentally in several women beyond the childbearing period. Deliberate sterilization was then attempted in a young woman, thirty-four years old, who was referred by her physician for sterilization. She gave a history of three pregnancies terminated by cesarean section, three pregnancies interrupted by therapeutic abortion, all done because of a justo-minor pelvis. The uterine cornu and tubal opening on the right side was coagulated under vision without difficulty. The cornu on the left side could not be reached by the instrument, even after repeated manipulation, due to a protruding mass in the uterine cavity which was not evident in the preliminary salpingogram. A second patient, twenty-eight years old, previously referred to, who had become pregnant a year after the first attempt at sterilization, was treated with coagulation under vision on the side which had re-opened. A third, thirty years old, with a history of two therapeutic abortions for severe toxemia of pregnancy with hyperemesis was also sterilized. There was no discomfort nor any unpleasant reaction in any of these cases. However, the lapse of time since sterilization is too short to more than state that the tubes are occluded at present. The permanent outcome is yet to be determined. Repeated careful observations of these patients and other similar cases will be recorded for publication at a future date.

#### CONCLUSIONS

1. Deliberate sterilization of the female is a necessary measure in those women in whom pregnancy is contra-indicated.
2. Surgical sterilization, the recognized method, is not always successful, and is attended by operative hazards in proportion to the gravity of the complicating condition.
3. A new instrument which conforms to the uterine cavity and is calibrated to its average measurements, is presented.
4. An improved intra-uterine technic is described whereby the in-

strument is introduced into the uterine cornu under direct vision with the fluoroscope, and the openings of the fallopian tubes are sealed by coagulation with the high frequency current.

5. The method is simple, free from untoward reaction, and does not interfere with the patient's occupation.

6. It has given promise of success in selected cases.

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