

A Review of Clinical Data for Currently Approved Hysteroscopic Sterilization Procedures

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Two hysteroscopic permanent sterilization procedures are approved for use in the United States: Essure® Permanent Birth Control System (Conceptus Incorporated, Mountain View, CA) and Adiana® Permanent Contraception (Hologic, Inc., Bedford, MA). This review compares the clinical trial data for these procedures. A notable difference is the resultant clinical pregnancy risk. The clinical trials for the Essure procedure have reported no pregnancies in 643 relying women in the 9 years since initiation of the studies. The clinical trial for the Adiana procedure has reported 12 pregnancies in 570 relying women in nearly 5 years of collected data. Other clinical outcome parameters concerning Essure and Adiana are examined in this review.

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In 2002, the US Food and Drug Administration (FDA) approved the first hysteroscopically placed sterilization device, the Essure® Permanent Birth Control System (Conceptus Inc., Mountain View, CA) for use in the United States. Since the approval of Essure, approximately 450,000 procedures have been performed worldwide.¹ Subsequently, in 2009, a second hysteroscopic sterilization procedure, Adiana® Permanent Contraception (Hologic, Inc., Bedford, MA), was approved by the FDA for commercial use.²

An increasing number of physicians are now trained to perform hysteroscopic sterilization. At the same time, these minimally invasive procedures are becoming increasingly popular with patients. Counseling concerning procedural and clinical outcome differences for Essure and Adiana is essential to assist patients

in selecting an appropriate hysteroscopic sterilization technique.

This review details the differences and similarities between the Essure and Adiana permanent contraceptive procedures. Clinical trial data as reported on the FDA Web site, the products' information for use (IFU) as included in each device packaging, information presented at annual meetings, and currently published literature from clinical trials are reviewed in detail. This review outlines differences with respect to effectiveness in pregnancy prevention, mechanism of action, ability to obtain accurate follow-up hysterosalpingogram (HSG), resources needed to accomplish the procedure, and other clinically significant issues.

Overview of Clinical Data

Two clinical trials were undertaken to assess the effectiveness, safety, and patient satisfaction of the Essure Permanent Birth Control System. The phase II trial, initiated in 1998, and the pivotal trial, initiated in 2000, were prospective, multicenter, international studies.^{3,4} Other clinical trials include the postapproval studies (PAS) for newly trained physicians for Essure delivery catheter models ESS205 and ESS305; these were prospective, multicenter studies designed to evaluate bilateral placement rates.^{1,5,6} Many peer-reviewed articles have been published since FDA approval of the device that have further increased knowledge about the device and the procedure in a commercial setting.

At the time of this writing, there has been a single published article on the Adiana procedure. The Evaluation of the Adiana System for Transcervical Sterilization (EASE) trial⁷ was initiated in 2002 and was a prospective, multicenter, single-arm, international clinical study undertaken to determine the efficacy, safety, and patient

satisfaction for the Adiana Permanent Contraceptive System. Further data for this review article were obtained from the Adiana IFU manual and information contained on the FDA's premarket approval report. No peer-reviewed articles have been published addressing efficacy in a commercial setting, although a few papers have been presented in a public forum.

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clinical trials for Essure, 0 pregnancies in 643 relying patients have been reported in the 9 years since initiation of the studies.⁵ The FDA recommended utilizing a statistical model, Bayesian analysis, to infer a clinical effectiveness rate of 99.71%, or a 0.29% failure rate, at 9 years.⁸ Interestingly, through 2008, a worldwide commercial use effectiveness rate of 99.85% (a 0.15% failure rate) has been reported based on documented commercial pregnancies and number of devices shipped. In determining the 0.15% failure, Conceptus included all reported pregnancies, including luteal phase pregnancies, pregnancies prior to 3-month HSG, pregnancies in patients who failed appropriate HSG follow-up, and pregnancies after reported bilateral occlusion confirmed by HSG.⁹ The vast number of pregnancies post-Essure were related to either nonadherence to protocols or HSG misinterpretation. Despite inclusion of all reported pregnancies, Essure has been proven to be the most effective sterilization procedure commercially available to date.¹⁰

In the EASE clinical trial for Adiana, 12 pregnancies in 570 relying patients have been reported in nearly 5 years of collected data. Data collec-

tion for patients in postprocedure years 4 and 5 continues, as not all women participating in the study have completed 5 years of follow-up.¹¹ If no further pregnancies are reported or no further patients lost to follow-up are included for reliance, the current effectiveness is 97.9%, or a failure rate of 2.1%. Six pregnancies were reported in the first year of reliance with 3 failures attributable to misread HSGs and 3 to procedural failures of unknown cause. Three

pregnancies were reported in the second year of reliance due to unknown causes. Although all women have not completed their fourth and fifth year of reliance at this time, 2 pregnancies have been reported thus far for women in the fourth year, and 1 pregnancy has been reported in the fifth year of reliance, all due to unknown causes.^{7,11,12} The FDA has requested that Hologic continue to follow patients for at least 10 years postprocedure to monitor for additional pregnancies.² As no commercial use data are available at this time, no further information concerning clinical effectiveness or outcomes can be reported.

Utilizing data from the US Collaborative Review of Sterilization (CREST) study, Essure and Adiana can be compared with other methods of sterilization. Table 1 reports the number of pregnancies by sterilization method per 1000 women per year.¹³ Failure rates for Essure compare favorably to all methods in the CREST study, with 0 of 1000 women experiencing failure with this method in 5 years based on clinical trial data. Essure's predicted failure rates utilizing the Bayesian method for statistical analysis are also included for reference.⁸ Failure rates for Adiana compare favorably only to

Table 1
Essure and Adiana Compared With Other Forms of
Sterilization Based on CREST Study Data¹³
(No. of Failures per 1000 Women)

Method	1 Year	2 Years	3 Years	4 Years	5 Years
Essure (trial)	0 ^a	0 ^a	0 ^a	0 ^a	0 ^a
Essure (Bayesian) ^b	0.32 ^b	0.68 ^b	1.02 ^b	1.32 ^b	1.64 ^b
Unipolar	0.7	2.3	2.3	2.3	2.3
Postpartum salpingectomy	0.6	3.9	4.6	5.4	6.3
Bipolar	2.3	4.6	6.7	13.1	16.5
Silicone ring	5.9	7.6	8.3	9.0	10.0
Interval salpingectomy	7.3	15.1	15.1	15.1	15.1
Adiana	10.5 ^a	15.8 ^a	15.8 ^a	19.3 ^c	21.1 ^c
Spring clip	18.2	23.8	29.1	30.7	31.7

CREST, US Collaborative Review of Sterilization trial; FDA, US Food and Drug Administration.

^aBased on clinical trial data and calculated by author.

^bFDA recommended projections based on Bayesian statistical analysis.

^cYear 4 and 5 data collection has not been fully reported to the FDA. Calculations are projected by author using the methodology of the CREST trial based on clinical trial data as reported to FDA to date, and on the assumption that no further pregnancies occur and no inclusion of patients lost to follow-up in the clinical trial.

Adiana® Permanent Contraception (Hologic, Inc., Bedford, MA).

Essure® Permanent Birth Control System (Conceptus Incorporated, Mountain View, CA).

spring clips in the CREST study, with a projected 21.1 of 1000 women experiencing failure with this method in 5 years, assuming no further pregnancies or inclusion of patients lost to follow-up in the clinical trial.

Essure Clinical Trials

Figure 1 depicts data from a combination of the phase II and pivotal clinical trials for Essure. In these studies, a combined 745 women underwent hysteroscopy. Eleven women were excluded due to anatomic factors preventing visualization of tubal ostia, leaving 734 women undergoing attempted device placement. Of the 734 women who underwent device placement, successful bilateral placement was achieved in 664 women (90.5%). Twenty-two women required a second procedure to achieve bilat-

eral placement and were included in the 664 women for analysis. Prior to 3-month HSG, 3 women were lost to follow-up and 5 were not evaluated with HSG; therefore a total of 656 women underwent 3-month HSG. During the 3-month HSG, 612 women were found to have bilateral occlusion and appropriately placed bilateral devices, and 23 women were determined to have tubal patency with appropriately placed devices. Twenty-one women were determined to have unsatisfactory HSG due to causes such as malplacement (ie, myometrial, too proximal, or too distal) or partial perforation. Nine of these women elected to have a second procedure to replace an expelled device, with subsequent successful placement. Of the 32 women obtaining 6-month HSGs, 31 were found to

have bilateral occlusion with no perforations, expelled devices, and no patencies. One patient was excluded due to use of a discontinued prototype device that did not use a dynamic outer coil to maintain stability within the fallopian tube and who became pregnant. In all, 643 of 664 women (96.8%) with bilateral placement were instructed to rely on the Essure devices for pregnancy prevention. In the subsequent 9 years since initiation of the study, no reports of pregnancy have been documented.^{3-5,8,10} In the phase II trial, 7 perforations in 206 women were reported, yielding a 3.4% perforation rate. During the pivotal trial, a new delivery catheter with less column strength was introduced for use and a perforation rate of 1.1% (5/476) was reported. However, a total of 12 perforations were noted in the clinical trials, and most were partial and through the fallopian tube. Two perforations were noted to be through the wall of the uterus with 1 patient having the device removed at the time of laparoscopic sterilization with no sequelae. The second woman underwent laparoscopic procedure for sterilization with inability to visualize the device; the device was left in situ and afterward the patient remained asymptomatic at least 3 years of follow-up. Finally, 1 woman with a partial device perforation experienced pelvic pain, requested removal of the devices, and operative removal of bilateral fallopian tubes and corneal resection were performed.^{3-5,10}

Two PAS trials were undertaken to assess bilateral placement rate on first attempt for Essure devices in newly trained and experienced physicians utilizing the updated delivery catheters ESS205 and ESS305. In the trial for ESS205, the second-generation delivery catheter, 370 women underwent attempted device placement with 350 women achieving bilateral placement, resulting in a 94.6% bilateral placement

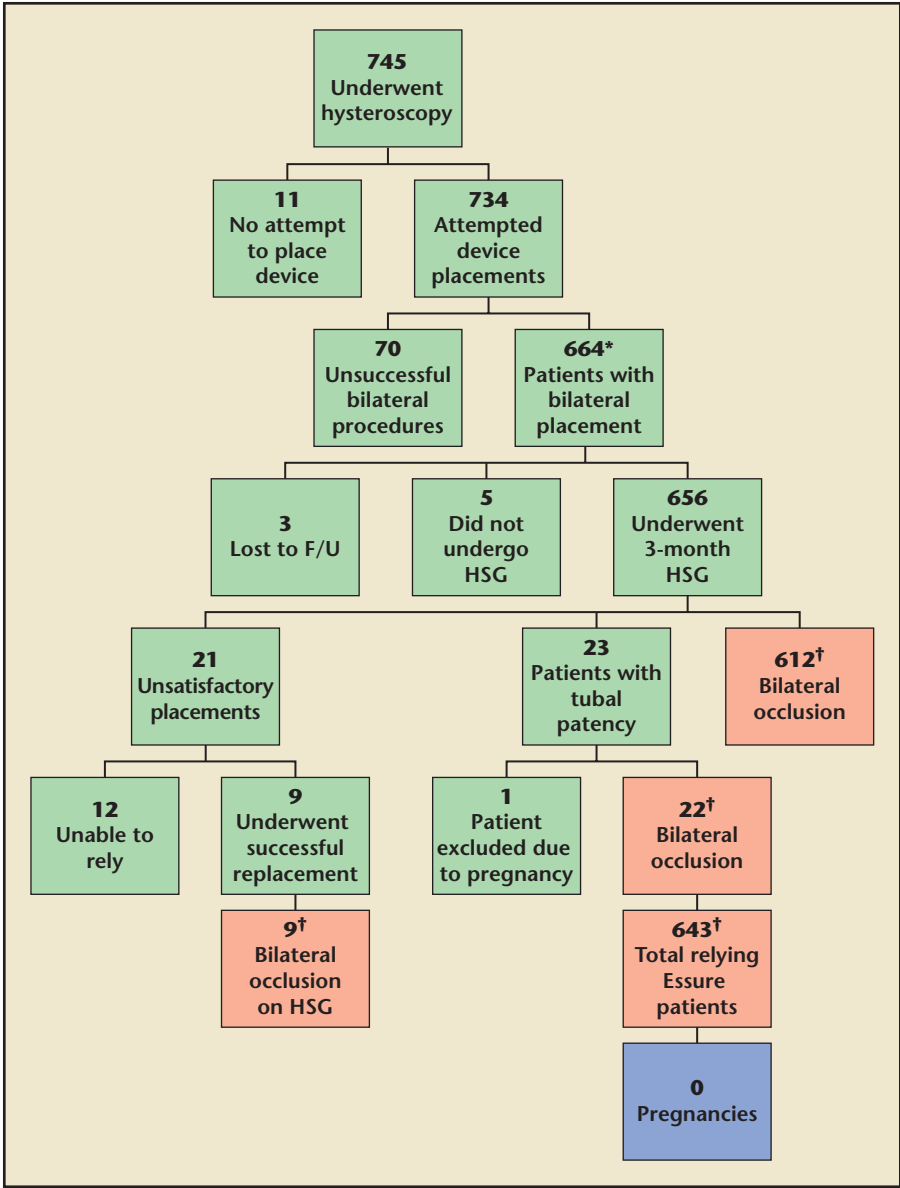


Figure 1. Essure® Permanent Birth Control System (Conceptus Incorporated, Mountain View, CA) clinical trial data (phase II trial, pivotal trial).³⁻⁵ *Twenty-two patients required a second procedure to achieve successful bilateral placement. †Boxes included to obtain total number of patients able to rely on Essure for pregnancy prevention. F/U, follow-up; HSG, hysterosalpingogram.

rate.⁵ In the preliminary results of the ESS305 trial, the third-generation delivery catheter, 571 women underwent attempted device placement with 549 achieving bilateral placement, resulting in a 96.2% bilateral placement rate.⁶ Subsequent final results of 612 women in the ESS305 PAS trial demonstrated bilateral placement in

593 subjects, resulting in a 96.9% bilateral placement rate. ESS305 is the only commercially available Essure device and has received an FDA-approved 96.9% bilateral placement rating.¹

Adiana Clinical Trial

Figure 2 depicts the EASE trial for Adiana. In this study, 655 women

underwent hysteroscopy. Ten women were excluded due to anatomic factors preventing visualization of tubal ostia, leaving 645 women undergoing attempted procedure. Of the women who underwent attempted procedure, successful bilateral treatment was achieved in 611 women (94.7%). As in the Essure trials, 7 women required a second procedure to achieve bilateral treatment and are included in the 611 women for analysis. Prior to 3-month HSG, 6 women were lost to follow-up, 1 woman became pregnant and was excluded from the study, and 604 women underwent a 3-month HSG. During the 3-month HSG, 551 women were found to have bilateral occlusion and 53 women were determined to have tubal patency. Of the 53 women, 1 woman was lost to follow-up, 2 women became pregnant, 5 were not re-evaluated, and 45 underwent a 6-month HSG. Of these 45 women, 19 (42%) were found to have bilateral occlusion whereas 26 (58%) women remained patent. In all, 570 of 611 women (93.3%) with bilateral placement were instructed to rely on the Adiana procedure for pregnancy prevention. Interestingly, the study protocol included ultrasound evaluation of silicone implants at both 1 week and 3 months.^{2,7,11} However, the authors did not report data concerning the findings of these ultrasounds. Therefore, it is uncertain how many implants were identified at these time intervals. In the subsequent 5 years of data collection, 12 pregnancies have been documented. In the first year of reliance, 1 woman experienced an ectopic pregnancy that was successfully treated with methotrexate and 5 women experienced intrauterine pregnancies. In the second year of reliance, 1 woman experienced an ectopic pregnancy requiring operative salpingectomy and 2 women experienced intrauterine pregnancies. No pregnancies were reported in year 3; 2 intrauterine

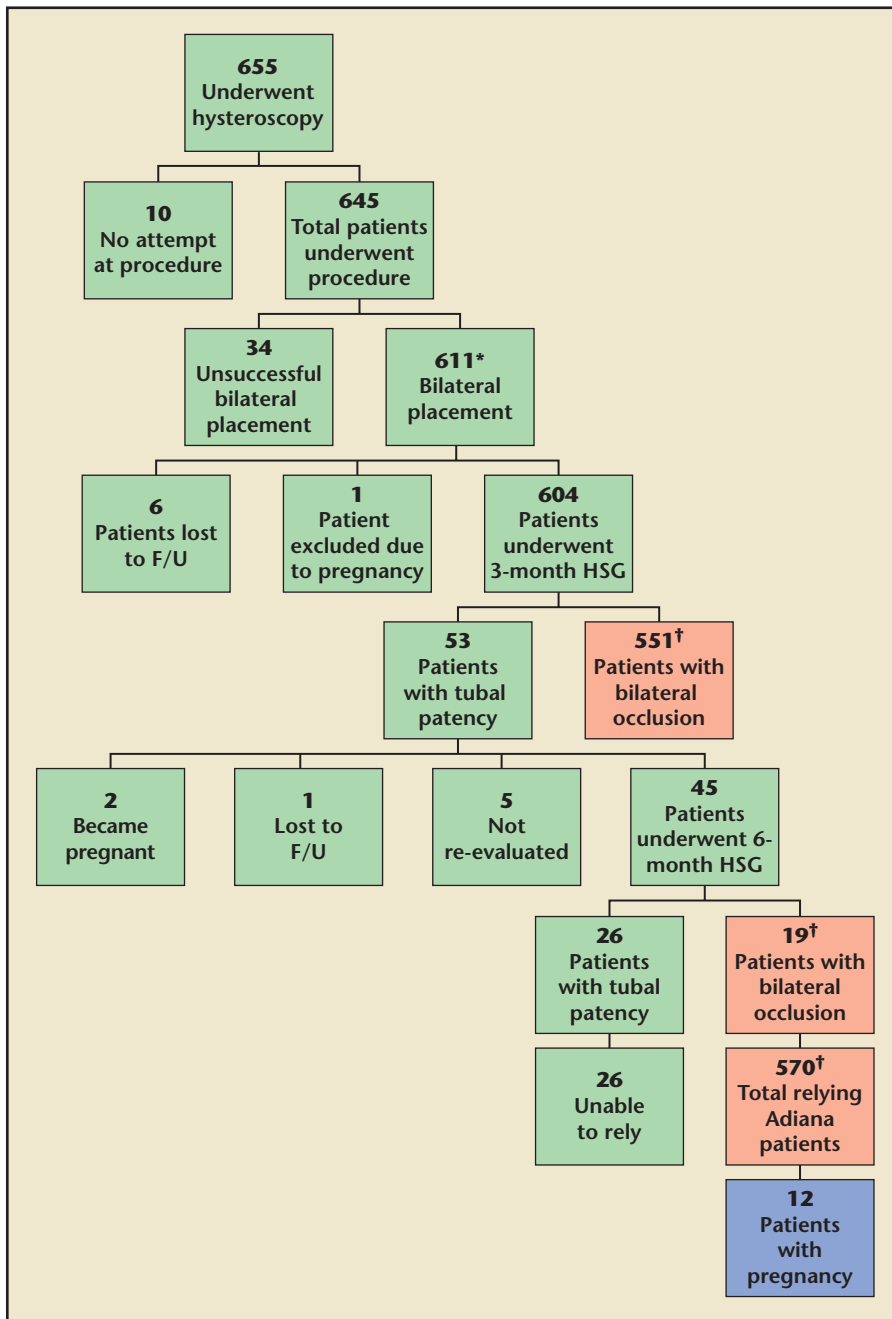


Figure 2. Adiana® Permanent Contraception (Hologic, Inc., Bedford, MA) clinical trial (Evaluation of the Adiana System for Transcervical Sterilization [EASE] trial).^{2,7,11} *Seven patients required a second procedure to obtain successful bilateral placement. †Boxes were included to obtain total number of patients able to rely on Adiana for pregnancy prevention. F/U, follow-up; HSG, hysterosalpingogram.

pregnancies were reported in year 4 and 1 intrauterine pregnancy was reported in year 5. Not all women have completed the full 5-year follow-up, so additional data may be reported concerning outcome in these patients.^{2,7,11,12}

Comparison of Clinical Trial Data

Although clinical trials for Essure and Adiana were well designed and appear to have been conducted in a similar fashion, analysis of data and, thus, reporting among the manufacturers are

not always consistent. Essure and Adiana represent very distinct procedures due to their mechanism of action and postprocedural evaluation. As the Essure insert is visible on radiographic imaging, certain clinical decisions and actions can be made when a tubal patency is encountered. For example, if the Essure insert has been expelled or was improperly placed in the myometrium, a clinician can elect to replace the Essure insert in the patent tube. In the clinical studies for Essure, women with replaced devices were able to achieve bilateral occlusion and were included in the results. With Adiana, due to the inability to visualize the insert on radiographic imaging, a clinician may have been unable to determine the exact cause of patency and these patients were necessarily excluded from the clinical study. Furthermore, more information, specifically with respect to adverse events such as expulsion, can be more readily identified and reported with a device that can be seen via radiographic imaging versus a device that is not detectable.

Utilizing the data from the Essure and Adiana clinical trials, various outcome parameters are reported in Table 2. The bilateral placement reliance rate represents the number of women who were ultimately instructed that they could rely on the sterilization procedure divided by the number of women who were considered to have successful bilateral placement in 1 or 2 attempts. In both studies, a small subset of women underwent 2 separate procedures to obtain successful bilateral performance and these women are included in effectiveness analysis. In the Essure study, some women with expelled devices underwent additional procedures and were eventually found to have bilateral occlusion. Ultimately, the bilateral placement reliance rate for Essure is 96.8% (643/664), whereas the

Table 2
Outcome Variables as Determined by Clinical Trial Data
for Essure and Adiana^{2,4,5,7,10,11,13,16}

Clinical Study Data	Essure ^a	Adiana
No. patients	734	645
Bilateral placement rate ^b	96.9% (593/612) ^c	94.7% (611/645)
No. patients able to rely on method	643	570
Bilateral placement reliance rate	96.8% (643/664)	93.3% (570/611)
HSG patency at 3 mo	3.5% (23/656) ^d	8.8% (53/604)
HSG patency at 6 mo	0% (0/656)	4.4% (26/596)
Patients unable to rely	1.8% (12/656)	4.4% (26/596)
Patients with perforations	1.8% (12/682) ^e	0 ^f
Patients with expulsions	2.2% (15/682) ^e	0 ^f
No. y follow-up	9 years	3–5 y ^g
No. pregnancies	0	12
Failure rate	0%	2.1%

EASE, Evaluation of the Adiana System for Transcervical Sterilization trial; FDA, US Food and Drug Administration; HSG, hysterosalpingogram.

^aUnless otherwise indicated, clinical study data for Essure includes combined data from the phase II and pivotal trials.

^bData for both Essure and Adiana include a subset of patients requiring a second attempt for successful placement.

^cCurrent FDA approved bilateral placement rate for only commercially available device ESS305.

^dData represent tubal patency with appropriate device placement.

^eDenominator represents expulsions/perforations at time of attempted placement and/or HSG diagnosis.

^fThe EASE trial did not report any expulsions/perforations.

^gAlthough all study participants have achieved 3-year follow-up, not all have reached either 4 or 5 years of follow-up at this time.

Adiana® Permanent Contraception (Hologic, Inc., Bedford, MA).

Essure® Permanent Birth Control System (Conceptus Incorporated, Mountain View, CA).

bilateral placement reliance rate for Adiana is 93.3% (570/611). It should be noted that more women required a second procedure to achieve bilateral success in the Essure clinical trials (3.9% in the pivotal trial and 2% in the phase II trial) than in the Adiana clinical trial (1.2% in the EASE trial).^{3,4,7}

In patients undergoing 3-month HSG, 8.8% of Adiana patients versus 6.7% of Essure patients had an unsatisfactory HSG despite a presumed successful bilateral placement. However, 1.8% and 2.2% of Essure patients experienced a perforation or

expulsion, respectively, with 3.5% representing true patency with appropriately placed Essure inserts. Nine women in the Essure expulsion group elected to have inserts replaced and all went on to have bilateral occlusion at 6-month HSG. All patients in the Essure group with proper location of Essure devices were occluded at 6 months, whereas 4.3% of Adiana patients remained patent and were unable to rely on the method for pregnancy prevention. It is worth noting that over half (57%) of the patients who failed a 3-month HSG with

Adiana also failed a 6-month HSG. Overall, 4.4% (26/596) of women in the Adiana trial were unable to rely on the procedure to prevent pregnancy despite following all clinical protocols due to persistent tubal patency at 6-month HSG. In comparison, 1.8% (12/656) of women in the Essure trials were unable to rely on the procedure to prevent pregnancy, despite following all clinical protocols, due to a combination of an expelled, partially or completely perforated, or misplaced device.

Mechanism of Action

The Essure and Adiana procedures represent a similar technique with respect to cannulation of the fallopian tube ostia. However, they represent different methods of achieving tubal occlusion.^{5,11}

The Essure microinsert is a dynamically expanding 4-cm microcoil that consists of a stainless steel inner coil; a nitinol expanding, superelastic outer coil; and polyethylene terephthalate (PET) fibers.⁴ The coil is delivered into the proximal portion of the fallopian tube via a disposable delivery system. Once the fallopian tube is cannulated, an Essure device is passed, deployed into the proximal fallopian tube, and the delivery catheter is removed. The procedure is then repeated on the opposite fallopian tube. Visual confirmation of appropriate placement of the Essure microcoil is obtained postdeployment via hysteroscopic and/or radiographic visualization. The PET fibers contained within the coil induce a benign, chronic inflammatory and fibrotic response along 3 to 4 cm of the inner fallopian tube that results in device retention and pregnancy prevention. PET fibers were chosen as a result of their effectiveness in other clinical settings such as prosthetic arterial grafts, percutaneous catheters, aneurysm coils, and other long-term implants.⁵

The Adiana procedure is a combination of the 60-second application of radiofrequency energy (RF) to the inner epithelial layer of the fallopian tube, followed by deployment of a 3.5-mm silicone matrix insert into the injured area via a disposable delivery system. The procedure is then repeated on the opposite tube.⁷ No

The proper evaluation of tubal occlusion via HSG (or any other method) will certainly be more difficult with the Adiana procedure due to the inability to visualize the insert during fluoroscopy. With the Essure device, the visual feedback that the devices are located properly within the fallopian tubes and the inability

procedures with subsequent successful bilateral occlusion of the fallopian tubes.³⁻⁵

In the IFU for Adiana, no expulsions or perforations were reported for the silicone insert. A 4-quadrant detection array is proposed as the de facto indicator of nonperforation of the fallopian tube. As no radio-opaque device is present after the Adiana procedure is complete, it is unclear how perforation or subserosal, uterine wall, or abdominal cavity placement could be diagnosed with this procedure, and, therefore, reported by the manufacturer. During the application review process, the FDA panel did recommend that animal studies be undertaken to validate this perforation detection feature.² To date, no known animal data have been reported confirming this assertion. Interestingly, in 2009, an abstract presentation by Bongers and Veersema¹⁴ reporting the evaluation of the silicone implants postprocedure using ultrasound failed to demonstrate an implant in some patients.¹⁴ Presumably the implants were either not reliably detected using ultrasound technology, not implanted at the time of the procedure, expelled into the uterine or peritoneal cavities, or perforated into the uterine cavity at the time of procedure. Although the authors of the EASE trial have reported no data with respect to ultrasound verification of the silicone matrix presence or absence at 1 week and 3 months postprocedure, future reporting of this information is needed to better evaluate this issue.

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visual confirmation of the silicone matrix or RF treatment of the fallopian tube can be obtained hysteroscopically after removal of the delivery catheter. Delivery of energy to the inner fallopian tube results in the initial injury causing an acute response, giving way to a more chronic process causing in-growth upon the silicone matrix. In addition, there appears to be a host response expected for soft-tissue implants such as the matrix.^{7,11}

Hysterosalpingogram

HSG is an integral portion of the Essure and Adiana procedures. Without the completion of an HSG indicating bilateral tubal occlusion, both the Essure and Adiana procedures are deemed unsuccessful and not reliable for prevention of pregnancy. In the clinical trials for Essure, there were no reports of misread HSGs, as no pregnancies were reported. Conversely, as a result of the 12 pregnancies after performance of the Adiana procedure, reviews of the HSG findings were undertaken in a systematic review to determine the cause of the pregnancies. After review, it was determined that 3 of the 12 pregnancies were related to a misread HSG, although there is no published information to determine what was insufficient.^{7,12}

to pass iodine contrast fluid beyond the device during HSG assist the physician in determining tubal occlusion.⁵ With the Adiana procedure, the physician cannot visualize the silicone implant fluoroscopically and only the inability to pass iodine contrast fluid through the fallopian tube serves to diagnose tubal occlusion.¹¹ The inability to see a properly placed and retained silicone matrix device with the Adiana procedure may lead to increased false-positive results with respect to occlusion and may account for the additional pregnancies seen in the EASE trial.

Finally, a 6-month HSG tubal patency for Essure and Adiana are noted to be 0% and 4.4%, respectively. The women in the Adiana trial with documented tubal patency at 6 months were instructed to use alternative means of contraception.⁷

Expulsion and Perforation

In the phase II and pivotal trials for Essure, a perforation rate of 1.8% (12/682) and an expulsion rate of 2.2% (15/682) were observed. These women were instructed that they could not rely on the Essure system for birth control even when the HSG may have revealed occlusion of the fallopian tubes. Nine women with expulsion of the Essure device elected to undergo repeat

Procedural Differences

Essure utilizes normal saline for uterine distention, whereas Adiana requires the use of nonionic distention media such as glycine, sorbitol, or mannitol.¹¹ Hypervolemia and hyponatremia risk is increased with

the use of nonionic distention media over solutions such as normal saline. Strict monitoring of inflow and outflow is an important aspect to both procedures. However, a smaller volume of nonionic distention media would result in hypervolemia and hyponatremia compared with normal saline in

with the Adiana because the procedure leaves no material in the uterine cavity.

Postpartum Use

Differences exist in the postpartum use of Essure and Adiana. Essure is approved for use in women who are

Both procedures report high patient satisfaction and tolerability in an office setting.

individual patients due to absorption of nonionic fluid into venous channels hysteroscopically.¹⁵ Additionally, intraoperative and postprocedure monitoring time may need modification in Adiana patients when compared with Essure patients to assess for fluid overload.

As nonionic solutions tend to crystallize upon drying, increased resources for cleaning of instrumentation may be necessary. Insufficient removal of nonionic solutions may result in malfunctioning or blockage of hysteroscopic ports.

During the Essure procedure, the manufacturer recommends that 3 to 8 trailing coils be visible postplacement. An advantage is the physician has hysteroscopic confirmation of bilateral cannulation and placement postprocedure. With respect to trailing coils, no studies or reports could be found in the literature reporting increased risks for abnormal uterine bleeding or coil dislodgement due to uterine sampling. Kerin and colleagues¹⁶ reported that the inserts are reliably encapsulated in the ostia and not exposed to the intrauterine cavity. In addition, successful pregnancies after in vitro fertilization have been widely reported in the literature, further asserting the benign nature of the trailing coils.¹⁰ However, the trailing coils may exclude certain future intrauterine procedures.⁵ This is not an issue

beyond 6 weeks postpartum, whereas Adiana is not approved for use until 12 weeks postpartum.^{5,11}

Similarities

Essure and Adiana perform very similarly with respect to procedure tolerability and patient satisfaction postprocedure: both procedures report high patient satisfaction and tolerability in an office setting.^{7,10}

Cost comparisons between the 2 procedures are unknown as no reports are currently available. The cost per patient for each system is essentially equal. The radiofrequency generator appears to require no additional financial burden for physicians as the generators are leased to physicians for use with the purchase of Adiana kits. Nonionic distention media are slightly more expensive than normal saline. Unknown factors for potential increased cost may result from the use of nonionic solutions such as glycine, as detailed previously, with respect to patient monitoring and instrument cleaning. However, because a detailed cost analysis has not been undertaken, definitive answers are not available at this time.

Conclusions

Advances in technology offer physicians innovative solutions for their patients' health needs. Hysteroscopic

sterilization represents a remarkable advancement in women's health, offering a safer and easier method for permanent birth control over laparoscopic techniques. However, as new technologies enter the marketplace, it is incumbent upon physicians to understand the differences and similarities that exist.

The major strength of Essure is the very high efficacy of the procedure—a 0% failure rate in clinical trials. Notably, outside the United States, no HSG confirmation is performed. Rather, plain film radiography or ultrasound is used to confirm appropriate location of the microinsert, resulting in a 0.15% pregnancy failure rate.¹⁰ Further strengths include an observed 100% tubal occlusion at 6 months in clinical trials with proper placement of the Essure device. This is reassuring considering the high number (up to 87%) of women who fail to comply with appropriate HSG follow-up.¹⁷ A weakness of the Essure procedure is the risk for perforation or expulsion of the device. Current practice based on commercial use suggests that removal of an Essure device found in the intra-abdominal cavity need not be undertaken as the device does not appear to cause bowel injury. Additionally, in the clinical trials, 1 patient did require laparotomy to remove bilateral Essure devices due to pain.³ Also, because the Essure device is a longer device in comparison with the Adiana treatment area and matrix implant, it would seem logical that proper cannulation of bilateral fallopian tubes may be more difficult or prolonged in some patients with tubal spasm. However, no major differences in successful bilateral placement were observed with use of the ESS305 delivery catheter when compared with Adiana (96.9% vs 94.7%).

The main advantage of Adiana may reside in the ability to cannulate fallopian tubes that may have more distal blockage or spasm that inhibits

the placement of an Essure device. For patients with a documented nickel allergy, Adiana offers a safe alternative to laparoscopic tubal sterilization. A potential adverse event related to the use of RF energy would presumably be bowel burns or abdominal surgery related to pain after the Adiana procedure. However, there have been no reports of these adverse events. Additionally, there have been no reports of prolonged pain due to the Adiana procedure requiring tubal resection. Expulsion or perforations may occur with the Adiana procedure. However, the silicone matrix is not detectable with fluoroscopy or radiographic imaging, making the diagnosis of an intra-abdominally placed silicone device virtually impossible. Some of the device failures may be due to unsatisfactory placement of silicone inserts or RF energy. However, it does remain that the authors of the EASE study reported no evidence of perforations or expulsions associated with the Adiana procedure.⁷ These advantages must be counterbalanced by the increased risk for pregnancy, including ectopic

pregnancy, with the Adiana device; 1 patient required operative treatment of ectopic pregnancy in the clinical trials.² As seen in the CREST study, the use of bipolar energy for tubal occlusion resulted in increasing the risk for failure over a 10-year period. Uncertainty exists as to whether the Adiana method for sterilization will have a similar clinical course.¹⁸ Another concern with Adiana is that fewer than half of women with patent tubes at 3 months (42% [19/45]) will actually occlude by 6 months. This is more troublesome when considering that a high proportion of women do not obtain recommended HSG follow-up.¹² As commercial use data become available, further information concerning risks and advantages of this procedure will increase.

Although Essure and Adiana may be similar procedures for physicians to perform, they represent very divergent technologies for sterilization. Each of these devices achieves the endpoint of sterilization in a unique manner and thus they have divergent efficacy for preventing pregnancy. Fortunately, both the Essure and

Adiana procedures offer distinct advantages over laparoscopic sterilization, with reduced need for anesthesia and decreased risk for injury to intra-abdominal organs. Although no procedure is perfect, physicians must appropriately weigh the risks and benefits of all available options for permanent sterilization to best treat their patients. ■

Dr. Basinski has provided consultant services to Conceptus Incorporated and Hologic, Inc.

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Main Points

- Six hundred forty-three of 664 women (96.8%) with bilateral placement were instructed to rely on the Essure devices for pregnancy prevention. In the subsequent 9 years since initiation of the study, no reports of pregnancy have been documented. Five hundred seventy of 611 women (93.3%) with bilateral placement were instructed to rely on Adiana procedure for pregnancy prevention. Interestingly, the study protocol included ultrasound evaluation of silicone implants at both 1 week and 3 months. In the subsequent 5 years of data collection, 12 pregnancies have been documented.
- As the Essure insert is visible on radiographic imaging, certain clinical decisions and actions can be made when a tubal patency is encountered. With Adiana, due to the inability to visualize the insert on radiographic imaging, a clinician is unable to determine the exact cause of patency.
- In the clinical trials for Essure, there were no reports of misread hysterosalpingograms, as no pregnancies were reported. Conversely, as a result of the 12 pregnancies after performance of the Adiana procedure, reviews of the HSG findings were undertaken in a systematic review to determine the cause of the pregnancy. After review, it was determined that 3 of the 12 pregnancies were related to a misread HSG, although there is no published information to determine what was insufficient.
- The cost per patient for each system is essentially equal.
- The major strength of Essure is the very high efficacy of the procedure—a 0% failure rate in clinical trials. The main advantage of Adiana may reside in the ability to cannulate fallopian tubes that may have more distal blockage or spasm that inhibits the placement of an Essure device.

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