

## USE OF COPPER INTRAUTERINE DEVICES AND THE RISK OF TUBAL INFERTILITY AMONG NULLIGRAVID WOMEN

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**ABSTRACT**

**Background** Previous studies of intrauterine devices (IUDs), many of which are no longer in use, suggested that they might cause tubal infertility. The concern that IUDs that contain copper — currently the most commonly used type — may increase the risk of infertility in nulligravid women has limited the use of this highly effective method of birth control.

**Methods** We conducted a case-control study of 1895 women recruited between 1997 and 1999. We enrolled 358 women with primary infertility who had tubal occlusion documented by hysterosalpingography, as well as 953 women with primary infertility who did not have tubal occlusion (infertile controls) and 584 primigravid women (pregnant controls). We collected information on the women's past use of contraceptives, including copper IUDs, previous sexual relationships, and history of genital tract infections. Each woman's blood was tested for antibodies to *Chlamydia trachomatis*. We used stratified analyses and logistic regression to assess the association between the previous use of a copper IUD and tubal occlusion.

**Results** In analyses involving the women with tubal occlusion and the infertile controls, the odds ratio for tubal occlusion associated with the previous use of a copper IUD was 1.0 (95 percent confidence interval, 0.6 to 1.7). When the primigravid women served as the controls, the corresponding odds ratio was 0.9 (95 percent confidence interval, 0.5 to 1.6). Tubal infertility was not associated with the duration of IUD use, the reason for the removal of the IUD, or the presence or absence of gynecologic problems related to its use. The presence of antibodies to chlamydia was associated with infertility.

**Conclusions** The previous use of a copper IUD is not associated with an increased risk of tubal occlusion among nulligravid women, whereas infection with *C. trachomatis* is. (N Engl J Med 2001;345:561-7.)

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**I**NTRAUTERINE devices (IUDs) have long been believed to cause pelvic inflammatory disease and subsequent tubal infertility. Many IUDs were withdrawn from the market in the United States and other countries because of concern about safety, and the use of one — the Dalkon Shield — was eventually shown to be strongly associated with pelvic inflammatory disease. Copper-containing IUDs were first approved for use in the United States in 1976 and are still being marketed. Lingering con-

cern about the potential risks of IUDs has discouraged women — particularly those who have never been pregnant — from using even copper devices.

Research on IUDs in the 1970s and 1980s was marked by confusion and controversy. Two early reports from the Women's Health Study in the United States showed that the use of an IUD increased the risk of pelvic inflammatory disease by at least 60 percent,<sup>1,2</sup> although subsequent reanalyses suggested a less marked increase in risk.<sup>3-5</sup> The Oxford Family Planning Association contraceptive study<sup>6,7</sup> initially reported that IUD use increased the risk of pelvic inflammatory disease by a factor of 10; however, a refined analysis using better comparison groups and separating results according to the type of device found no significant increase in the risk of pelvic inflammatory disease with medicated devices such as copper IUDs.<sup>8</sup> More recent studies by the World Health Organization<sup>9</sup> and by a team of researchers in the United States<sup>10</sup> found that the incidence of pelvic inflammatory disease among IUD users is less than 2 episodes per 1000 years of use, consistent with conservative estimates of the incidence of pelvic inflammatory disease in the general population.<sup>11</sup> A recent meta-analysis of 36 studies concluded that the use of any IUD is positively associated with pelvic inflammatory disease.<sup>12</sup> Good evidence suggests that the increase in the risk of pelvic inflammatory disease associated with IUD use is related only to the process of inserting the device and that after the first month of use, the risk of infection is not significantly higher than that in women without IUDs.<sup>13</sup>

The recognized association between pelvic inflammatory disease and tubal infertility<sup>14</sup> has aroused some concern that the use of an IUD may lead to this complication. Two case-control studies in the United States published more than 15 years ago<sup>15,16</sup> reported positive associations between IUD use and tubal infertility. In subanalyses evaluating the risk according to the type of IUD used, copper devices were reported to increase the risk of tubal infertility in one study<sup>16</sup> (though only among women with more than one sexual partner) but not in the other<sup>15</sup>; however, later reanalysis of the data in the second study suggested an increased risk of infertility associated

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with the copper IUD.<sup>17</sup> Since then, numerous case-control studies<sup>18-21</sup> and cohort studies<sup>22-25</sup> have attempted to clarify the relation, but controversy has persisted.

## METHODS

We conducted an unmatched case-control study in three public hospitals in Mexico City, Mexico (the National Perinatology Institute, Gynecology and Obstetrics Hospital Number 4 of the Mexican Social Security Institute, and the Women's Hospital). All consecutive nulligravid, infertile women 18 years of age or older who were scheduled for diagnostic hysterosalpingography were invited to participate. Infertility was defined by the failure to conceive after one year or more of unprotected intercourse. Criteria for exclusion included previous pregnancy, tubal sterilization, and previous diagnostic laparoscopy. After undergoing hysterosalpingography, the infertile women were classified on the basis of the radiologic evidence as women with tubal occlusion (case subjects) or as infertile controls. From the same hospitals, we recruited a second control group consisting of primigravid women in their first or second trimester. In face-to-face interviews lasting an average of 20 minutes, all participants were asked about their past use of contraceptives, previous sexual relationships, and history of genital tract infections; the interviews with the infertile women were conducted before they knew whether they had tubal occlusion. The instruments for recording the results of hysterosalpingography were adapted from the recommendations of the American Fertility Society (now the American Society for Reproductive Medicine).<sup>26</sup> Participants also donated a sample of blood to be tested for antibodies to *Chlamydia trachomatis*. The institutional review boards of Family Health International and the participating hospitals approved the study; written informed consent was obtained from all enrolled women. Recruitment began in September 1997 and was completed in October 1999; data analysis was completed in December 2000.

We recruited 1311 infertile women (358 women with tubal occlusion and 953 controls) and 584 pregnant controls; fewer than 5 percent of the women who met the eligibility criteria declined to participate. We designed the study to have 90 percent power to detect a doubling of the risk of tubal occlusion with IUD use in analyses involving the infertile controls; the study had 87 percent power to detect a doubling of the risk in analyses involving the pregnant controls (two-sided test, 0.05 alpha level).<sup>27</sup> If we set the power at the standard 80 percent level, we had enough study subjects to detect odds ratios of 1.8 and 1.9 in analyses involving the infertile controls and the pregnant controls, respectively.

Before recruitment began, the radiologists met to standardize their approach to classifying tubal pathology. Tubal occlusion was diagnosed if a water-based contrast medium failed to spill from either tube into the peritoneal cavity. Fluoroscopy was used, and the last films were taken 15 minutes after the contrast medium had been injected. The radiologists were unaware of the information collected in the women's interviews.

Serologic tests for detecting antibodies to chlamydia are accepted measures of past infection.<sup>28-30</sup> An indirect fluorescent IgG antibody-staining kit (Hemagen Diagnostics, Columbia, Md.) was used to process the serum samples. As in previous studies using these kits, samples that tested positive at dilutions of 1:256 were considered diagnostic of past exposure to *C. trachomatis*.<sup>31</sup> All serum samples were processed as recommended by the manufacturer.

Our primary exposure variable was the previous use or nonuse of an IUD containing copper. Other variables that were considered as possibly predictive of tubal infertility included the presence or absence of antibodies to *C. trachomatis*, the number of lifetime sexual partners, the presence or absence of a history of genital tract infections, the presence or absence of a history of gynecologic symptoms suggestive of infection, the past use or nonuse of other methods of contraception, family income, education, employment status, and the presence or absence of a history of coitus during the teenage years. Regarding their most recent sexual partners

(up to six), the women were asked about the length of the relationship and whether they believed their partners had engaged in concurrent sexual relations with other women. To adjust for age, we used the age when the infertile women first suspected they were unable to conceive and the age when the pregnant women first began attempting to conceive. We excluded from the analyses exposure that occurred after the onset of infertility.

We classified women into one of six mutually exclusive groups on the basis of use of contraceptive methods: no previous method (or rhythm or withdrawal), condoms only, vaginal spermicides only, hormonal methods only (oral or injectable contraceptives), condoms and hormonal methods, and IUDs (none of the women reported a history of diaphragm use). If a previous user of vaginal spermicides had also used one of the other methods, she was assigned to the group that used that other method. All women who had used an IUD reported having used a device containing copper. The vast majority of the copper IUDs used by the women in the study were T-shaped (containing either 220 mm<sup>2</sup> or 380 mm<sup>2</sup> of copper surface). Data were collected on the duration of use of a given method, any gynecologic problems that occurred during its use, and the reasons for the discontinuation of its use.

We calculated crude and adjusted odds ratios (with 95 percent confidence intervals) as measures of the association between IUD use and tubal occlusion. Logistic regression was used to control for other factors simultaneously.

## RESULTS

The infertile women with tubal occlusion (case subjects) and the infertile controls were similar in terms of level of education, employment status, family income, and number of months spent attempting to conceive (Table 1). As compared with the women with tubal occlusion, the pregnant controls were younger, better educated, and less likely to work outside the home and had lower family incomes.

The prevalence of the possible risk factors for tubal occlusion was similar among the women with tubal occlusion and the infertile controls (Table 2). However, as compared with the women with tubal occlusion, the pregnant controls had had more sexual partners, were more likely to report suspected infidelity by partners, and had lower rates of previous upper genital tract infection, symptoms of pelvic inflammatory disease, and positive tests for antibodies to chlamydia.

When no previous contraceptive use was defined as the reference category, previous use of a copper IUD was not associated with an increased risk of tubal occlusion either in the analysis including the infertile controls (odds ratio, 1.0; 95 percent confidence interval, 0.6 to 1.6) or in the analysis including the pregnant controls (odds ratio, 0.7; 95 percent confidence interval, 0.4 to 1.2) (Table 3). In the latter analysis, women whose sexual partners used condoms had a 50 percent lower risk of tubal occlusion than those who used no contraception.

Similarly, when no previous IUD use was defined as the reference category, previous use of a copper IUD was not associated with tubal occlusion in the analyses including either the infertile controls (odds ratio, 1.0; 95 percent confidence interval, 0.6 to 1.7) or the pregnant controls (odds ratio, 0.9; 95 percent confidence interval, 0.5 to 1.6) (Table 4). A longer

**TABLE 1.** SELECTED CHARACTERISTICS OF THE INFERTILE AND PREGNANT WOMEN.

CHARACTERISTIC	INFERTILE WOMEN WITH TUBAL OCCLUSION (N=358)	INFERTILE CONTROLS (N=953)	PREGNANT CONTROLS (N=584)
Age at interview*†			
≤24 yr	59 (16.5)	210 (22.0)	321 (55.0)
25–29 yr	139 (38.8)	409 (42.9)	121 (20.7)
30–34 yr	135 (37.7)	289 (30.3)	68 (11.6)
≥35 yr	25 (7.0)	45 (4.7)	74 (12.7)
Adjusted age‡			
≤24 yr	194 (54.2)	530 (55.6)	347 (59.4)
25–29 yr	109 (30.4)	324 (34.0)	117 (20.0)
30–34 yr	51 (14.2)	91 (9.5)	58 (9.9)
≥35 yr	4 (1.1)	8 (0.8)	62 (10.6)
Years of education§			
≤6	55 (15.4)	118 (12.4)	50 (8.6)
7–11	140 (39.1)	377 (39.6)	252 (43.2)
12–14	117 (32.7)	335 (35.2)	196 (33.6)
≥15	46 (12.8)	123 (12.9)	86 (14.7)
Employed outside home¶			
No	228 (63.7)	634 (66.5)	416 (71.2)
Yes	130 (36.3)	318 (33.4)	168 (28.8)
Family income‡			
≤Median	174 (48.6)	443 (46.5)	364 (62.3)
>Median	184 (51.4)	510 (53.5)	220 (37.7)
Median no. of months attempting to conceive	48	48	4

\*P=0.008 by the chi-square test for the comparison between the women with tubal occlusion and the infertile controls.

†P=0.001 by the chi-square test for the comparison between the women with tubal occlusion and the pregnant controls.

‡The adjusted age is the age when an infertile woman first suspected she was infertile or the age when a pregnant control first tried to conceive.

§P=0.01 by the chi-square test for the comparison between the women with tubal occlusion and the pregnant controls.

¶P=0.02 by the chi-square test for the comparison between the women with tubal occlusion and the pregnant controls. Data were missing for one infertile control.

duration of use of a copper IUD, the removal of the IUD because of side effects, and a history of gynecologic symptoms during the use of a copper IUD were not associated with increased odds of tubal occlusion.

The presence of antibodies to *C. trachomatis* among women who had not used a copper IUD was associated with tubal occlusion (odds ratio, 2.4; 95 percent confidence interval, 1.7 to 3.2) in the analysis including the pregnant controls (Table 5). Among women who had used an IUD, there was no significant association between antibodies to *C. trachomatis* and tubal infertility, but there were relatively few women in this group.

We considered using a broader definition of a case to include either tubal occlusion or adhesions, but hysterosalpingography has a limited ability to identify adhesions.<sup>32,33</sup> To address the concern that our case

**TABLE 2.** POSSIBLE RISK FACTORS FOR TUBAL OCCLUSION.

RISK FACTOR	INFERTILE WOMEN WITH TUBAL OCCLUSION (N=358)	INFERTILE CONTROLS (N=953)	PREGNANT CONTROLS (N=584)
No. of sexual partners*†			
1	234 (65.4)	684 (71.8)	343 (58.7)
2	79 (22.1)	168 (17.6)	138 (23.6)
3 or 4	39 (10.9)	83 (8.7)	66 (11.3)
≥5	6 (1.7)	18 (1.9)	37 (6.3)
Suspicion that a partner was unfaithful‡			
No or don't know	279 (77.9)	757 (79.4)	420 (71.9)
Yes	79 (22.1)	196 (20.6)	164 (28.1)
History of upper genital tract infection§			
No	348 (97.2)	923 (96.9)	582 (99.7)
Yes	10 (2.8)	30 (3.1)	2 (0.3)
History of lower genital tract infection¶			
No	336 (93.9)	874 (91.7)	556 (95.2)
Yes	22 (6.1)	79 (8.3)	28 (4.8)
Previous symptoms of pelvic inflammatory disease  **			
No	193 (53.9)	494 (51.8)	471 (80.7)
Yes	165 (46.1)	459 (48.2)	113 (19.3)
Antibodies to <i>Chlamydia trachomatis</i>			
No	221 (61.7)	616 (64.6)	452 (77.4)
Yes	137 (38.3)	337 (35.4)	132 (22.6)
Previous use of any contraceptive method			
No	206 (57.5)	556 (58.3)	319 (54.6)
Yes	152 (42.5)	397 (41.7)	265 (45.4)
Previous use of a copper IUD††			
No	335 (93.6)	896 (94.0)	544 (93.2)
Yes	23 (6.4)	57 (6.0)	40 (6.8)

\*P=0.006 by the chi-square test for the comparison between the women with tubal occlusion and the pregnant controls.

†For infertile women, data are the number of different partners before a fertility problem was suspected.

‡P=0.04 by the chi-square test for the comparison between the women with tubal occlusion and the pregnant controls.

§P=0.002 by Fisher's exact test for the comparison between the women with tubal occlusion and the pregnant controls. The woman recalled receiving a diagnosis of pelvic inflammatory disease, endometritis, adnexitis, or salpingitis.

¶The woman recalled receiving a diagnosis of trichomoniasis, genital herpes, gonorrhea, syphilis, chlamydia, cervicitis, or nonspecific leukorrhea.

||P=0.001 by Fisher's exact test for the comparison between the women with tubal occlusion and the pregnant controls.

\*\*Symptoms of pelvic inflammatory disease include intermenstrual abdominal pain, dyspareunia, or pain during a pelvic exam.

††IUD denotes intrauterine device. For infertile women, data are for use before the suspected onset of infertility.

group was defined too narrowly because we excluded women who had adhesions only, we performed an additional analysis. This analysis involved reclassifying as case subjects the infertile controls who had no occlusion but had adhesions identified on hysterosalpingography and positive serologic tests for *C. tra-*

**TABLE 3. PREVIOUS USE OF CONTRACEPTIVES AND THE RISK OF TUBAL OCCLUSION.\***

CONTRACEPTIVES USED	INFERTILE WOMEN WITH TUBAL OCCLUSION (N=357)	INFERTILE CONTROLS (N=948)	ODDS RATIO (95% CI)	PREGNANT CONTROLS (N=583)	ODDS RATIO (95% CI)†
	no. (%)			no. (%)	
No method‡	222 (62.2)	583 (61.5)	1.0	319 (54.7)	1.0
Condoms only	48 (13.4)	135 (14.2)	0.9 (0.6–1.3)	123 (21.1)	0.5 (0.3–0.7)
Hormonal methods only	33 (9.2)	73 (7.7)	1.2 (0.7–1.8)	41 (7.0)	1.1 (0.7–1.8)
Condoms or hormonal methods	31 (8.7)	100 (10.5)	0.8 (0.5–1.3)	60 (10.3)	0.6 (0.4–1.1)
Any copper IUD	23 (6.4)	57 (6.0)	1.0 (0.6–1.6)	40 (6.9)	0.7 (0.4–1.2)

\*For infertile women, data represent the method used before the women suspected a fertility problem. Contraceptive methods include hormonal methods (oral contraceptives and injectables), vaginal spermicides or gels, condoms, and intrauterine devices (IUDs). The categories were mutually exclusive. One woman with tubal occlusion, five infertile controls, and one pregnant control, all of whom previously used only vaginal spermicide or gel, were excluded from this analysis. Women who used vaginal spermicide or gel in addition to other contraceptives are included in the categories for the other contraceptive methods. The ratios have been adjusted for age, income, number of sexual partners, years of education, and history of sexual intercourse during the teenage years. CI denotes confidence interval.

†The odds ratios are for the comparison between the pregnant controls and the infertile women with tubal occlusion.

‡Women with no previous use of contraception served as the reference group. Users of the rhythm method and withdrawal are included in this category.

**TABLE 4. HISTORY OF USE OF A COPPER IUD AND THE RISK OF TUBAL OCCLUSION.\***

PREVIOUS USE OF A COPPER IUD	INFERTILE WOMEN WITH TUBAL OCCLUSION (N=358)	INFERTILE CONTROLS (N=953)	ODDS RATIO (95% CI)	PREGNANT CONTROLS (N=584)	ODDS RATIO (95% CI)†
	no. (%)			no. (%)	
No	335 (93.6)	896 (94.0)	1.0	544 (93.2)	1.0
Yes	23 (6.4)	57 (6.0)	1.0 (0.6–1.7)	40 (6.8)	0.9 (0.5–1.6)
Duration of use					
≤6 mo	9 (2.5)	27 (2.8)	0.8 (0.4–1.8)	11 (1.9)	1.4 (0.6–3.6)
7–12 mo	6 (1.7)	15 (1.6)	1.1 (0.4–2.8)	8 (1.4)	1.0 (0.3–3.0)
≥13 mo	8 (2.2)	15 (1.6)	1.3 (0.6–3.2)	21 (3.6)	0.6 (0.3–1.4)
IUD removed because of side effects					
Yes	11 (3.1)	33 (3.5)	0.8 (0.4–1.7)	13 (2.2)	1.4 (0.6–3.2)
No	12 (3.4)	24 (2.5)	1.3 (0.6–2.7)	27 (4.6)	0.7 (0.3–1.4)
Gynecologic problems during use					
Yes	16 (4.5)	41 (4.3)	1.0 (0.6–1.8)	21 (3.6)	1.2 (0.6–2.4)
No	7 (2.0)	16 (1.7)	1.1 (0.4–2.6)	19 (3.3)	0.6 (0.2–1.4)

\*For infertile women, data represent the use of a copper intrauterine device (IUD) before the women suspected a fertility problem. In each analysis, the women with no previous use of a copper IUD served as the reference group. The odds ratios have been adjusted for age, income, number of sexual partners, years of education, and history of sexual intercourse during the teenage years. CI denotes confidence interval.

†The odds ratios are for the comparison with the infertile women with tubal occlusion.

*chomatis*. Previous research suggests that serologic testing for chlamydia may improve the accuracy of the diagnosis of tubal disease when used in conjunction with, or even in place of, hysterosalpingography.<sup>34,35</sup> After this reclassification, the adjusted odds ratios for tubal infertility associated with IUD use were 1.2

(95 percent confidence interval, 0.7 to 1.9) for the analysis including the infertile controls and 1.0 (95 percent confidence interval, 0.6 to 1.5) for that including the pregnant controls.

Although hysterosalpingography is the standard method for evaluating tubal patency,<sup>36</sup> it has some

**TABLE 5.** USE OF A COPPER IUD, THE PRESENCE OF ANTIBODIES TO *CHLAMYDIA TRACHOMATIS*, AND THE RISK OF TUBAL OCCLUSION.\*

IUD USE AND PRESENCE OF ANTIBODIES TO CHLAMYDIA	INFERTILE WOMEN WITH TUBAL OCCLUSION (N=358)	INFERTILE CONTROLS (N=953)	ODDS RATIO (95% CI)	PREGNANT CONTROLS (N=584)	ODDS RATIO (95% CI)†
	no. (%)			no. (%)	
No use of a copper IUD					
Antibody-negative	203 (56.7)	583 (61.2)	1.0	420 (71.9)	1.0
Antibody-positive	132 (36.9)	313 (32.8)	1.2 (0.9–1.6)	124 (21.2)	2.4 (1.7–3.2)
Use of a copper IUD					
Antibody-negative	18 (5.0)	33 (3.5)	1.5 (0.8–2.8)	32 (5.5)	1.1 (0.6–2.1)
Antibody-positive	5 (1.4)	24 (2.5)	0.6 (0.2–1.5)	8 (1.4)	1.3 (0.4–4.1)

\*For infertile women, data represent the use of a copper intrauterine device (IUD) before the women suspected a fertility problem. Antibody titers of 1:256 or greater were considered positive. For all comparisons, women with no use of a copper IUD and no antibodies to chlamydia served as the reference group. The ratios were adjusted for age, income, number of sexual partners, years of education, and history of sexual intercourse during the teenage years. CI denotes confidence interval.

†The odds ratios are for the comparison with the infertile women with tubal occlusion.

diagnostic limitations that laparoscopy does not have. Of the 1311 infertile women in our study, only 321 (24 percent) underwent laparoscopy. Those with abnormal results on hysterosalpingography were twice as likely as women with negative results to undergo laparoscopy. Using the laparoscopy reports, we divided this subgroup into 185 women with any evidence of tubal disease, including adhesions, and 136 infertile controls with no evidence of tubal disease. The adjusted odds ratio for tubal infertility associated with previous IUD use was 1.5 (95 percent confidence interval, 0.7 to 3.5) in analyses including the infertile controls and 1.9 (95 percent confidence interval, 1.0 to 3.5) in analyses using the pregnant controls.

**DISCUSSION**

Our finding that the use of a copper IUD was not a risk factor for tubal occlusion among nulligravid women contradicts some previous reports that aroused concern about future fertility in women who use copper IUDs.<sup>15,16</sup> Given the media attention to the problems with the Dalkon Shield and the associated litigation in U.S. courts during the 1970s and 1980s, women who were infertile and had previously used an IUD may have been more inclined to investigate the cause of their condition than infertile women who had never used an IUD. Consequently, women with a history of IUD use may have been disproportionately represented in previous studies in the United States of women with tubal infertility. In contrast, our study was conducted in Mexico, where IUD use is well accepted and where such bias is unlikely to occur.

Past research on this topic used only primigravid women as controls. We included an infertile control

group for several reasons. First, we wanted to ensure that the women with tubal occlusion came from the same population as the controls. Second, this approach minimizes bias due to the differential recall of IUD use according to diagnosis. We also included a control group of pregnant women to address the association between IUD use and the inability to conceive.

Exposure to *C. trachomatis* has been cited as an important cause of tubal infertility.<sup>21,37</sup> We found higher rates of positive tests for antibodies to chlamydia, a validated marker of past exposure,<sup>28-30</sup> among women with tubal occlusion and among infertile controls than among pregnant women. A weakness of the antibody test is that it does not indicate whether exposure to *C. trachomatis* preceded the onset of tubal disease, although it is likely that it did. The fact that the prevalence of antibodies was similar among women with tubal occlusion and infertile controls is not surprising, since the infertile controls may have had other evidence of disease attributable to chlamydia, such as adhesions, which are not readily detectable by hysterosalpingography.<sup>32,33</sup> Thus, it is possible that previous studies found an increased risk of tubal infertility associated with the use of a copper IUD because of the unmeasured confounding effect of exposure to sexually transmitted disease — specifically, *C. trachomatis*.

Laparoscopy is another diagnostic procedure for women with infertility. The decision about whether to undergo laparoscopy is an individual one that depends on clinical findings (including those from hysterosalpingography) and other factors, such as the presence or absence of a history of pelvic pain. In our study, only one quarter of the women underwent

laparoscopy, including a disproportionate number of those with abnormal results on hysterosalpingography. The adjusted odds ratios for tubal infertility according to the analysis of the women who underwent laparoscopy, although higher than those calculated on the basis of all the women who underwent hysterosalpingography, were not inconsistent with the results of the primary analysis, and the differences between these ratios may reflect selection bias. An unbiased study in which laparoscopy was required for the identification of cases would not be feasible because of its cost, the time it would consume, and the ethical problems it would raise. Our analysis, based on hysterosalpingographic results, focused on damage to the lumen of the fallopian tubes; it is unlikely that we found no increased risk associated with IUD use simply because copper IUDs affect only structures exterior to the fallopian tubes.

More than 100 million women worldwide use IUDs. Asia accounts for the majority of use, but IUD use is also common among married women of reproductive age in Scandinavian countries (prevalence, 18 percent) and in other European countries (7 percent).<sup>38</sup> In contrast, only 1 percent of women in the United States use the IUD.<sup>39</sup> This low rate is thought to reflect the widespread concern about health risks associated with the method. In lieu of using an IUD, women may prematurely request sterilization (and may regret it later<sup>40,41</sup>), choose less effective or less convenient methods, or risk an unwanted pregnancy.

This study suggests that the use of copper IUDs is much safer than was previously thought. Nulligravid women who are not at risk for a sexually transmitted disease are appropriate candidates for the copper IUD. Contemporary copper IUDs may be among the safest, most effective, and least expensive reversible contraceptives available.<sup>42,43</sup>

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