Induced Abortion and the Risk of Subsequent Ectopic Pregnancy

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Abstract: This study assessed the effect of legal induced abortion on ectopic pregnancy risk by using a comparison group of reproductive-age women who were at risk of becoming pregnant during the same time period the women with ectopic pregnancy conceived. Cases were members of Group Health Cooperative of Puget Sound who were hospitalized for ectopic pregnancy from October 1981 through September 1986 (N = 211). Controls were randomly selected members matched to cases on age and county of residence (N = 457). All subjects in this analysis had had one or more prior pregnancies.

Eighty-eight cases (41.7 per cent) and 177 controls (38.7 per cent) had a history of one or more induced abortions. The relative risk of ectopic pregnancy associated with one abortion was 0.9 (95 per cent confidence interval 0.6, 1.3), adjusted for age, county, reference date, religion, gravidity, age at first pregnancy, lifetime number of sexual partners, and miscarriage history. Among women with two or more prior pregnancies, the risk associated with two or more abortions was 1.2 (0.6, 2.4). Controlling for pelvic inflammatory disease and use of intrauterine devices did not alter these risks. We conclude that legal abortion as performed in the US since 1970 has little or no influence on a woman's risk of ectopic pregnancy in subsequent pregnancies. (*Am J Public Health* 1989; 79:1234–1238.)

Introduction

The rate of ectopic pregnancy in the United States tripled between 1970 and 1983, from 4.2 to 12.6 per 10,000 women between 15 and 44 years of age.[1,2] Although improved diagnostic capabilities may be responsible for enhanced case finding, it seems likely that this increase in rates reflects a substantial actual increase in ectopic pregnancy incidence.[3] During the same time period, the incidence of induced abortions rose from 5 per 1,000 women 15 to 44 years in 1970 to 23 per 1,000 in 1983.[4,5] This parallel increase suggests the possibility that induced abortion may predispose to a subsequent ectopic pregnancy. A possible basis for such a predisposition could be fallopian tube scar tissue formation associated with salpingitis, since induced abortion has the potential to introduce salpingitis-causing organisms via contaminated instruments or cause organisms already present in the vagina to ascend.[3,6]

The results of recent US research concerning the association between induced abortion and ectopic pregnancy have been generally reassuring, but not conclusive. Chung's prospective cohort study in Hawaii found no increased risk.[7] In case-control studies, however, both Daling, *et al*, and Levin, *et al*, found a weak association between a history of multiple abortions and ectopic pregnancy, but the studies were small and chance effects plausible.[8,9] Both case-control studies compared cases to controls chosen from women delivering a liveborn child. Such a control group may underrepresent women with a history of induced abortion and create an artifactual relation between abortion and ectopic pregnancy in the absence of a real association.[10] The present study sought to eliminate this potential bias by the use of randomly selected reproductive-age women as a comparison group.

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Methods

Case Identification

Eligible cases were all women members 18 years of age or older who were hospitalized with the diagnosis of ectopic pregnancy at Group Health Cooperative of Puget Sound hospitals between October 1, 1981 and September 30, 1986. Group Health Cooperative is a prepaid health care cooperative founded in 1947; it serves over 320,000 residents of western Washington State. Cases were identified using a computerized hospital discharge system that has been in use at Group Health Cooperative since 1972.

Each patient's primary care physician at Group Health Cooperative was sent a letter describing the study and asking permission to contact the patient. If he or she consented, the Group Health Cooperative Research Department mailed a letter with a self-addressed card to the subject, asking her to return the card to indicate whether or not she wished to participate. If she agreed to participate, the interviewer telephoned her to explain what her participation in the study would involve, answer any questions about the study, and arrange for the interview. Subjects signed consent forms and medical records releases at the interview. Of the 396 patients identified as eligible from hospital records, primary care physicians refused permission to contact 11. In addition, 39 patients refused to participate, and nine could not be reached. A total of 337 cases were interviewed, 85.1 per cent of those eligible (Table 1).

An estimate of the date a case conceived her ectopic pregnancy was considered her "reference date." All questionnaire information gathered pertained to exposures and characteristics prior to that date.

Control Identification

Controls were women of child-bearing age identified

TABLE 1—Subject Response by Case Status

Total Subjects Identified	Cases		Controls	
	N = 396	(%)	N = 1139	(%)
Interviewed	337	(85.1)	893	(78.4)
MD refusal	11	(2.8)	32	(2.8)
Patient refusal	39	(9.8)	168	(14.7)
Lost to follow-up	9	(2.3)	46	(4.0)

from Group Health Cooperative membership files. They were selected randomly, and matched to cases by age and county of residence. Ages were matched as closely as possible: within one year for the majority of subjects, extending to a maximum of five years for one set. Two potential controls were initially selected for each case, and if either of them was unreachable or declined to participate, further controls were selected. Efforts continued to enlist the participation of everyone who was initially selected. Consequently, in many instances more than two controls were matched to each case. Controls were assigned a reference date which was the midpoint of the three-month quarter containing the reference date of the case to whom they were matched (Table 2). To be eligible, a control had to be a Group Health Cooperative member at her assigned reference date. After a potential control was identified, her primary physician was notified. If the physician gave permission for her to be contacted, the same sequence of events was followed as for cases. Of 1,139 potential controls identified, 32 were not contacted due to physician request. When contacted, 168 women refused to participate, and 46 could not be reached. Eight hundred ninety-three control subjects were interviewed, 78.4 per cent of those eligible (Table 1).

Potential controls whose husbands or partners were sterilized were excluded from consideration if the sterilization had not been reversed. Women with a history of hysterectomy or no sexual activity for the 12 months preceding the reference date were also excluded from the control group. Also, women four to nine months pregnant at the reference date, and therefore not at risk of being diagnosed as having an ectopic pregnancy, were identified from Group Health Cooperative prenatal files and excluded as potential control subjects.

Data Collection

Ninety-nine per cent of the cases and 95 per cent of the controls were interviewed in person. During the interviews, which lasted an average of 56 minutes, respondents were queried concerning their reproductive, contraceptive, sexual, and medical histories, past hygienic practices including douching, and demographic and lifestyle characteristics. For each induced abortion, information obtained included gestational age, abortion method, medical setting where the procedure was performed, and whether infection occurred after the abortion.

To decrease the possibility of recall bias, month by month calendars of all contraceptive, reproductive and other important personal events were formulated and discussed by interviewers and all subjects. The interviewers were not blinded to the subjects' diagnoses, but when 24 cases and 66 controls were contacted again and reinterviewed with selected questions by a different interviewer, the responses were in agreement 97 per cent of the time for cases and 95 per cent for controls.

As part of a substudy on the validity of self-reported data, the medical records of all subjects who reported intrauterine device (IUD) use and a random sample of 20 per cent of other subjects were reviewed. Information obtained from medical charts included history of induced abortion. Interview and chart information agreed for 264 of 285 subjects for whom there was information from the chart (Table 3).

Analysis

For this analysis, cases (n = 23) and controls (n = 14) with a prior ectopic pregnancy were excluded. Also excluded from both groups were women without a pregnancy prior to reference date (65 cases and 263 controls), and women who had had an induced abortion before 1970 when abortion became legal in Washington State (two cases and 15 controls). All surgically sterilized women (35 cases and 153 controls) were excluded since they already had their fallopian tubes occluded, the hypothesized means by which induced abortion could predispose to an increased risk of ectopic pregnancy. Seven cases with nontubal ectopic pregnancies (six ovarian and one abdominal) were excluded. Five subjects (one case and four controls) were excluded due to missing data for key model variables. Two hundred ten cases and 453 controls remained for analysis.

Multiple logistic regression analysis was performed to control for matching variables (age, reference date, county) and to adjust for the confounding effect of other exposures.[11] Relative risks approximated by odds ratios were estimated by the method of maximum likelihood. Significance tests were based on the chi-squared approximation for the likelihood ratio statistic, and 95 per cent confidence intervals were based on the standard error of coefficient estimates and the normal approximation.

Dichotomous variables considered in the analysis were education (≤12 years vs >12 years), marital status at refer-

TABLE 2—Case and Control Comparability on Matching Variables

Variables	Cases N = 211	Cases (%)	Controls N = 457	Controls (%)
Age (years) at reference date				
<20	7	(3.3)	3	(0.7)
20–24	34	(16.1)	56	(12.3)
25–29	55	(26.1)	133	(29.1)
30–34	83	(39.3)	183	(40.0)
35+	32	(15.2)	82	(17.9)
Reference year				
1981	16	(7.6)	19	(4.2)
1982	50	(23.7)	98	(21.4)
1983	36	(17.1)	92	(20.1)
1984	50	(23.7)	103	(22.5)
1985	41	(19.4)	91	(19.9)
1986	18	(8.5)	54	(11.8)
County of residence				
King	140	(66.4)	307	(67.2)
Pierce	28	(13.3)	71	(15.5)
Snohomish	19	(9.0)	27	(5.9)
Thurston	20	(9.5)	45	(9.8)
Other	4	(1.8)	7	(1.5)

TABLE 3—Comparison of Induced Abortion History Between Interview and Medical Chart Information

	Medical Chart: No[a]		Medical Chart: Yes		Medical Chart: Unknown	
Interview	N	(%)	N	(%)	N	(%)
Cases						
No	66	(57.9)	5	(4.4)	3	(2.6)
Yes	3	(2.6)	35	(30.7)	2	(1.8)
Controls						
No	106	(59.9)	4	(2.3)	0	
Yes	9	(5.1)	57	(32.2)	1	(0.6)

[a]Includes women whose medical record data does not cover the same pre-reference date time period reported in the interview.

ence date (married, living as married or steady partner vs separated, divorced, or never married), ever-use of oral contraceptives, ever-use of Dalkon Shield or other IUD, current use of contraceptives, history of douching, miscarriage, gonorrhea, pelvic inflammatory disease (PID), and endometriosis. Two dichotomous variables were used for abortion history: one abortion vs none, and two or more vs none. Categorical variables included cigarette smoking (never, former, current), race (Black, White, other), religion (Catholic, Protestant, other, none), age (<20 years, 20–24, 25–29, 30–34, 35+), family income (<$15,000 per year, $15–30,000, >$30,000), reference year (1981–82, 1983–84, 1985–86), duration of barrier contraceptive use (no use, <2 years, 2–4 years, 5+ years), lifetime number of sex partners (one, 2–4, 5+), age at first regular intercourse (<18 years, 18–20, 21+), age at first pregnancy (<20 years, 20–24, 25+), and gravidity (one, two, three or more pregnancies).

Results

A higher percentage of cases than controls were Black (Table 4). Cases were also more likely to have a family income under $15,000 per year and to be current cigarette smokers. Average age at first regular intercourse and age at first pregnancy were lower for cases than controls, while the cases had had a higher lifetime number of sexual partners. Case women also reported a history of PID more frequently than control women, with 4.7 per cent of cases and 3.3 per cent of controls reporting a first episode of PID occurring after their first abortion. IUD ever-use was slightly greater among cases, due to their higher frequency of Dalkon Shield IUD use. Controlling for either PID history or IUD usage did not alter the risk of ectopic pregnancy associated with induced abortion. Cases were more than three times as likely not to be contracepting at reference date than controls (Table 4), but abortion history did not differ between women using and those not using contraception at reference date (Table 5).

Eighty-eight cases (41.7 per cent) and 177 controls (38.7 per cent) had had one or more induced abortions (Table 6). The relative risk of ectopic pregnancy associated with a history of one induced abortion was 0.9 (95 per cent confidence interval 0.6, 1.3) when adjusted for age, county of residence, reference date, religion, age at first pregnancy, number of pregnancies, lifetime number of sexual partners, and prior miscarriage history. Among women with two or more prior pregnancies (125 cases and 288 controls), the relative risk for two or more abortions was 1.2 (95 per cent CI = 0.6, 2.4).

Method of abortion, gestational length, and site where abortion was performed did not vary appreciably between cases and controls (Table 7). Cases reported pain for longer than one week after last abortion twice as often as controls, but this result could be due to chance. The mean time from last abortion to reference date was 64.8 months for cases and 68.8 months for controls.

Discussion

We found little if any increased risk of ectopic pregnancy associated with prior induced abortion. Generalization of these results to a population outside the United States or to one for whom induced abortion is not legal may be misleading since the manner in which abortions are performed may influence their effect on ectopic pregnancy risk.

Ascertainment of abortion exposure was based on subject self-report in this study. If selective underreporting by cases or controls existed, our estimates of relative risk may be biased. Information from the substudy on validity of self-reported data indicates a small amount of underreporting

TABLE 4—Selected Demographic Characteristics

Demographic Characteristics	Cases N = 211	Cases (%)	Controls N = 457	Controls (%)
Race				
White	171	(81.0)	392	(85.8)
Black	29	(13.7)	31	(6.8)
Other (Asian, Hispanic, Native American, others)	11	(5.2)	34	(7.4)
Religion[a]				
Catholic	45	(21.3)	87	(19.1)
Protestant	88	(41.7)	225	(49.5)
None	63	(29.9)	106	(23.3)
Other	15	(7.1)	37	(8.1)
Education				
≤12 years	66	(31.3)	135	(29.5)
>12 years	145	(68.7)	322	(70.5)
Family Income[b]				
<$15,000/year	48	(22.7)	70	(15.4)
$15–30,000	92	(43.6)	211	(46.4)
>$30,000	71	(33.6)	173	(38.0)
Cigarette Smoking Status				
Never	89	(42.2)	238	(52.1)
Former	41	(19.4)	89	(19.5)
Current	81	(38.4)	130	(28.4)
Marital Status				
Married	142	(67.3)	321	(70.2)
Living as married	27	(12.8)	34	(7.4)
Separated	5	(2.4)	9	(2.0)
Divorced	7	(3.3)	23	(5.0)
Never married	5	(2.4)	24	(5.3)
Steady partner, living separately	25	(11.8)	46	(10.1)
History of PID[c]	33	(15.6)	37	(8.1)
IUD ever-use[d]				
None	134	(63.5)	311	(68.1)
Dalkon Shield	25	(11.8)	26	(5.7)
Non-Dalkon Shield only	50	(23.7)	117	(25.6)
Number of pregnancies before reference date				
1	86	(40.8)	169	(37.0)
2	60	(28.4)	150	(32.8)
3	31	(14.7)	83	(18.2)
4 or more	34	(16.1)	55	(12.0)
Number of miscarriages before reference date				
0	142	(67.3)	374	(81.8)
1	50	(23.7)	63	(13.8)
2 or more	19	(9.0)	20	(4.3)
Number of births before reference date				
0	60	(28.4)	103	(22.5)
1	91	(43.1)	165	(36.1)
2	43	(20.4)	133	(29.1)
3 or more	17	(8.1)	56	(12.3)
Age at first pregnancy				
<21 years	102	(48.3)	151	(33.0)
21–24 years	56	(26.5)	171	(37.4)
25+ years	53	(25.1)	135	(29.5)
Age at first regular intercourse				
<18 years	63	(29.9)	103	(22.5)
18–20 years	99	(46.9)	203	(44.4)
21+ years	49	(23.2)	151	(33.0)
Lifetime number of sexual partners[e]				
One	27	(12.8)	125	(27.4)
Two to four	75	(35.5)	146	(31.9)
Five or more	108	(51.2)	184	(40.3)
Contracepting at reference date				
Yes	44	(20.9)	320	(70.0)
No	167	(79.1)	137	(30.0)

[a]Two controls were uncertain. [b]Three controls refused to answer this question. [c]One case and six controls were uncertain. [d]Two cases and three controls were uncertain of type used. [e]One case and two controls refused to answer this question.

TABLE 5—Abortion History by Contraceptive Use at Reference Date

Abortion History	Not contracepting at reference date N = 304	(%)	Contracepting at reference date N = 364	(%)
Number of Induced Abortions				
0	186	(61.1)	217	(59.6)
1	82	(27.0)	100	(27.5)
2 or more	36	(11.8)	47	(12.9)

TABLE 6—Standardized Relative Risks of Ectopic Pregnancy According to Abortion History

	Cases N = 211	(%)	Controls N = 457	(%)	Relative Risk* (95% CI)
Number of Induced Abortions					
0	123	(58.3)	280	(61.3)	1.0
1	55	(26.1)	127	(27.8)	0.9 (0.6, 1.3)
2 or more	33	(15.6)	50	(10.9)	1.2** (0.6, 2.4)

*Adjusted for age, county, reference date, religion, gravidity, age at first pregnancy, lifetime number of sexual partners, and prior miscarriage history, using a multiple logistic regression model.

**Compared to women with two or more prior pregnancies, no induced abortions.

TABLE 7—Characteristics of Last Induced Abortion in Women with One or More Abortions

Characteristics	Cases N = 88	(%)	Controls N = 177	(%)
Abortion Method				
Suction	71	(80.7)	137	(77.4)
Dilatation and Curettage	9	(10.2)	19	(10.7)
Saline Infusion	5	(5.7)	8	(4.5)
Prostaglandin Infusion	1	(1.1)	1	(0.6)
Other	1	(1.1)	1	(0.6)
Uncertain	1	(1.1)	11	(6.2)
Complications				
Infection	2	(2.3)	9	(5.1)
Bleeding > one week	2	(2.3)	6	(3.4)
Pain > one week	11	(12.5)	11	(6.2)
D & C after abortion	3	(3.4)	7	(4.0)
Hospitalization after abortion	0	(0.0)	4	(2.3)
Length of Gestation				
First trimester	81	(92.0)	165	(93.2)
Second trimester	7	(8.0)	12	(6.8)
Median length (wks)	8.0		8.0	
Laminaria Used	20	(22.7)	35	(19.8)
Site abortion performed				
MD office	14	(15.9)	44	(24.9)
Freestanding clinic	37	(42.0)	65	(36.7)
Hospital or hospital clinic	36	(40.9)	68	(38.4)
Mean time from last abortion to reference date (months)		64.8		68.8

of prior induced abortion status may have been present. Four per cent of cases and 2 per cent of controls denied a history of induced abortion during their study interview, but had such a history noted in their medical charts. If the chart information more closely represents actual abortion history, our results may be a slight underestimate of the true effect. In our study, 42 per cent of cases and 39 per cent of controls stated they had had one or more induced abortions, whereas a study of Washington state multigravida women giving birth in 1984 and 1985 found that 25.6 per cent reported a prior abortion on the birth certificates in a random sample.[12] Since our subjects reported a considerably higher frequency of abortion history, we may be somewhat reassured that substantial underreporting does not exist.

Recent US studies have disagreed about the extent to which abortion is a risk factor for subsequent ectopic pregnancy. In case-control studies, Daling, *et al*, and Levin, *et al*, both found a modestly elevated ectopic pregnancy risk in women with a history of one abortion (Daling RR = 1.4, Levin RR = 1.3), and a somewhat higher risk associated with multiple induced abortions (Daling RR = 1.8, Levin RR = 2.6).[8,9] However, in both studies the number of cases with two or more abortions was small and associations found could have been attributable to chance. Moreover, both researchers chose controls delivering a child at a time comparable to the case's ectopic pregnancy surgery, and by definition this control group did not include women who conceived but chose to terminate that pregnancy. The cases had no similar termination opportunity, as ectopic pregnancy usually manifests itself before a woman's knowledge of her pregnant status. Since women terminating pregnancies have been estimated to have a higher frequency of past abortions than do women carrying a full-term pregnancy, use of these control groups may have led to an artificially elevated ectopic pregnancy risk associated with prior abortion.[10] Although Daling, *et al*, attempted to correct for this bias by limiting their study to married women and controlling for contraceptive use at time of conception, we believe our use of a more general population control group is a more direct way to address this issue.

Chung's Hawaiian study followed a large cohort of women who had abortions performed in the four years immediately following legalization of the procedure in Hawaii in 1970. The researchers found little increased risk associated with abortion in general (RR = 1.2), but did find a strong association (RR = 5.1) between abortion and ectopic pregnancy in women who had post-abortion infection or retained products of conception.[7] In our study, post-abortion infection was identified by 2.3 per cent of the cases and 5.1 per cent of the controls who had a history of abortion, and was not a risk factor for subsequent ectopic pregnancy. One difference between our study and Chung's which may account for this discrepancy is the time period during which the study was conducted. As years pass since the legalization of induced abortion in Washington State in 1970, physician expertise in the performance of the procedures may be improving, thereby minimizing risk to the patient. The abortion procedure itself has also changed over the past two decades, with decreased use of dilatation and curettage (used in 10 per cent of our cases' and 11 per cent of our controls' last abortion) and increased use of less traumatic suction procedures (used in 81 per cent of cases' and 77 per cent of controls' last abortion).

In conclusion, this study yields no evidence that legal abortions performed since 1970 in our study population led to increased risk of ectopic pregnancy in subsequent pregnancies. We found no increase in risk in women with a history of one induced abortion (RR = 0.9), and the slightly increased risk we found to be associated with multiple abortions (RR = 1.2) could easily have been due to chance. Providing that the

Group Health Cooperative experience is similar to that of other populations within the US, these results argue that the increasing rate of induced abortions is not an important factor in explaining the sharp rise in ectopic pregnancy incidence in this country in the past two decades.

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Yale University to Strengthen Its Public Health Program

A Yale University committee released a report in mid-July recommending to President Benno C. Schmidt Jr. a strategy to strengthen teaching and research in public health at the institution. The committee, which deliberated over six months, gathered information from faculty, students, alumni, and local and national leaders in public health. The basic goals of the committee's recommendations are to establish a leadership role for Yale in the arena of public health. In its report, the committee emphasized that the public health profession plays a critically important role in protecting and improving the physical and mental well-being of the nation.

Specifically, the committee recommended that the Department of Epidemiology and Public Health remain a department of the School of Medicine within which it will retain its status as a school for purposes of accreditation. To signal clearly the comprehensive mission of the department, the Committee suggests that the department be renamed the Department of Public Health. Burton H. Singer, PhD, professor of public health and the head of the biostatistics division, was named to a two-year term as Chairman of the Department of Public Health and Associate Dean for Public Health. A native of Chicago, Dr. Singer received BS and MS degrees from Case Institute of Technology in 1959 and 1961, respectively. In 1967, he received a PhD degree in statistics from Stanford University; he joined the Yale faculty in 1985. Dr. Singer succeeds Jan A. J. Stolwijk, PhD, who has completed seven years as Chairman and previously announced that he would return to full-time teaching and research.

Other recommendations for public health at Yale that the president will consider include:

- Establishing a standard committee within the School of Medicine to ensure ways of integrating teaching and research programs in public health with medicine;
- Allocating new resources to the department for the purpose of renovation of facilities and the recruitment of faculty;
- Strengthening the process for recruitment and admission of students;
- Strengthening ties between the Department of Public Health and other interested units of the University;
- Renovation and expansion of public health facilities at 60 College Street for public health programs;
- Increasing the size of the faculty by recruiting up to eight new faculty members;
- Strengthening the Master of Public Health Program by reorganizing the student admission process and focusing on the development of leaders in the field.

Founded in 1915, the present Department of Epidemiology and Public Health is a nationally accredited school of public health. It is among the oldest of 23 such schools in the United States and one of the few that is a department within a medical school.