

Induced abortions among women having undergone total hip replacement – a nationwide register study in Finland

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Abstract (250 words)

Background & Aims

No previous studies have analyzed the connection between total hip replacement (THR) and induced abortion (IA). We evaluated the nationwide IA rates among women with and without THR.

Materials and Methods

Data for this cohort study were gathered from national registers from 1987 to 2007. All fertile-aged (15 to 44 years old) females who had undergone primary THR in were selected. The THR patient group comprised 1 713 women and the reference group 5 148 women. Information on all pregnancies for both groups before and after THR/index date was gathered from the medical birth register and the register of IA. Logistic regression model was used to analyze the adjusted odds ratio (OR) for IA. Adjustment was made for age at IA, parity, previous IAs, previous deliveries, and marital status.

Results

Women had higher IA proportions after THR (17.9%) compared with women before THR (14.1%) and the referents (13.9%), but the differences were not statistically significant. Women in the THR patient group had significantly more IAs after THR due to maternal health issues (14.7%) compared with the referents (2.7%), $p=0.003$. Patients in the THR group were not more likely to have their pregnancy ending in IA than the women in the reference group (OR 1.32, 95% CI 0.89 – 1.96, $p=0.17$). In the adjusted analysis, there was a trend for higher risk for pregnancy to end in IA in the THR group in relation to the reference group (adjusted OR 1.50 (CI 0.99 – 2.28, $p=0.05$).

Conclusion

The THR patient group had higher, but statistically insignificant, IA proportions compared with the reference group before and after the operation. After THR, the patients were not more likely to

have a pregnancy ending in IA. This finding remained statistically insignificant after adjusting with possible confounders.

Key words: Total hip replacement, Orthopaedics, Joint replacement, induced abortion, reproduction, cohort study, register study, pregnancy, epidemiology

Introduction

Total hip replacement (THR) is a highly effective surgical procedure (1) that results in major improvements in the patients' quality of life, pain, sleep, physical ability, and sexual function (2-4). The main indications for THR in patients under 30 years of age are rheumatoid arthritis (RA) (36%) and avascular necrosis (23%) (5), whereas indications for overall primary THR for all ages in Finland are primary osteoarthritis (78%) and RA (7%) (6).

In Finland, the total number of primary THR per year has grown from slightly over 5 000 in 2000 to over 10 000 in 2017 (7). Of these, almost 60 % of patients were female. Every year, almost 500 THRs are carried out on patients under 50. The number of patients in this age group has grown slightly since 2003 (7). In 2007, the incidence of THR for young patients (30 to 49 years old) was 39 per 100 000 person years and the incidences increased slightly from 1980 to 2007 (8).

A few studies with small sample sizes and regional data have investigated the effects of THR on pregnancies and deliveries and vice versa. According to these previous studies, THR does not seem to be a contraindication for pregnancy or delivery (9, 10). Moreover, neither pregnancy nor delivery decrease implant survival after THR. (9-13) Women who have undergone THR seem to have lower fertility rates (14). One reason for the lower fertility rates might be that women have concerns about pregnancy and delivery after THR (9). These findings could therefore implicate reproductive problems or an increased IA rate.

The rate of induced abortions (IA) in Finland was 8.7 per 1 000 fertile-aged women (15 to 49 years old) in 2013 (15), which was the lowest rate in the Nordic countries. In 2013, the IA rate for the Nordic countries was 13.5/1 000 fertile-aged women. Although rates of IA have been stable in the Nordic countries for much of the 21st century, a small decline has been seen during the last two years (15). Overall, the worldwide rate of IA has been stable (29/1 000 fertile-aged women in 2003

vs. 28/1 000 in 2008). (16) The main indications for IA in Finland are social reasons (91.8%), fetal defects (3.4%), female aged over 40 at the start of the pregnancy (3.1%) and female aged under 17 at the start of the pregnancy (2.7%) (15).

Women with a lower socioeconomic status (SES) have a higher risk for IA compared with those of a higher SES (17). A Brazilian study estimated that women over 40 years of age or unmarried have more induced abortions than any other group (18). Furthermore, a previous induced abortion may lead to repeat abortion (19, 20). In addition, a short time between delivery and the next pregnancy increases the risk for abortion (21).

To the best of our knowledge, no previous studies have evaluated the relationship between THR and IA. The aim of the present study is therefore to investigate whether women with THR have a higher risk of IA compared with a reference group without THR at the national level.

Materials and methods

In this nationwide register-based retrospective cohort study, data were obtained from five national health registers: the Finnish Arthroplasty Register (FAR), the Register of Induced Abortions (RIA), the Finnish Population Information System, the National Medical Birth Register (MBR), and the register of medical reimbursements (RMR) due to chronic diseases maintained by the Social Insurance Institution of Finland.

The THR patient group consisted of all fertile-aged women (15 to 44 years old) who had undergone their first primary THR in Finland between 1987 and 2007. The THR patients were identified from the FAR that is maintained by Finnish National Institute for Health and Welfare

(THL). The FAR contains information on all hip and knee prostheses carried out in Finland. All the information in the FAR has been collected prospectively. The current (2017) completeness of the register is 95 % for primary THR and it matches well with data from the Finnish Hospital Discharge Register (7).

For every THR patient, three reference persons without THR were obtained from the Population Information System maintained by the Finnish Population Register Center. These reference persons were individually matched to THR patients by age, place of residence, and mother tongue. Information on the number of biological children born to the patients and the referents before the end of 2007 was also gathered from the Population information system. The index date for the referents was the day their matching patient underwent THR.

Information on IAs from 1987 to 2007 was obtained from the RIA. The RIA contains information on abortion rates and indications, as well as background information on females who have undergone IA. The overall coverage of the RIA is high, as is the validity of most of the variables. However, some problems have been reported with the coverage of SES and gestational age (22).

Information on pregnancies from 1987 to 2007 was obtained from the MBR. The register contains information on all births after gestational week 22+0 or birth weight over 500 grams. The MBR also contains information on maternal background characteristics, pregnancy history, pregnancy and delivery diagnoses, and neonatal data up to 7 days after birth. The MBR has high coverage and good quality of data, which has improved over time (23).

The RMR contains information on reimbursable costs due to chronic diseases. For reimbursement, a medical certificate issued by a certified doctor is required. Information on RA was gathered for

study population and participants with no record of RA reimbursement in the RMR were classified as not having the disease.

The start of the abortion follow-up was the 1st of January 1987 or the day the patient turned 15 years old, whichever occurred last. The endpoints for the abortion follow-up were the 31st of December 2007, or the date of the patients' 45th birthday, emigration or death, whichever occurred first.

Ethics

All the data were linked with the unique identification number assigned to all residents of Finland. In accordance with Finnish regulations, no informed written consent was required because participants in the study were not contacted individually. Permission for the data use was granted by the register holders. Permission number: THL/599/5.05.00/2010.

Statistics

The logistic regression-model was used to evaluate whether THR increased the risk of IA. Both unadjusted and adjusted odds ratios (OR) with 95 % confidence intervals (CI) were ~~conducted~~ calculated. ~~and~~ In the adjusted model, the ~~included the~~ following potential confounders or modifiers were adjusted for: age at time of abortion, parity, previous induced abortions, previous deliveries, and marital status.

Comparisons between the groups both before and after the THR/ index date on abortion rates as well as on indications for abortions were ~~made~~ carried out. Chi square test or Fischer's exact test was used to analyze categorized variables between the THR patient group and the reference group. The CI for the difference between two proportions (later as proportion difference=PD)

were used to evaluate the intergroup differences before THR and after THR in the THR patient group and before and after index date in the reference group. Statistical analyses were conducted with IBM SPSS for windows version 22 software. P-values under 0.05 were considered statistically significant.

Results

The total number of female participants in this study was 6 861. Among these, a total of 6 608 pregnancies and 885 (13.4%) induced abortions occurred. The THR patient group comprised 1 713 women, with 1 274 pregnancies and 187 (14.7%) induced abortions. Of these, 199 pregnancies and 35 (17.9%) induced abortions occurred after the THR. The reference group comprised 5 148 women with 5 334 pregnancies and 698 (13.1%) induced abortions. Of these, 1 308 pregnancies and 182 (13.9%) induced abortions occurred after the index date. Mean age at the beginning of the abortion follow-up was 27.4 years and mean age at the THR/index date was 37.3 years in both groups. The basic demographics of the patients and the referents are presented in Table 1.

In the patient group, the abortion rate was 9.0/1 000 person years (pyrs) before the THR and 3.9 /1 000 pyrs after the THR. In the reference group, the rates were 10.2 /1 000 pyrs before the index date and 6.6 /1 000 pyrs after the index date. In the patient group, abortion rates were 17/100 births before the index date and 21/100 births after the index date. In the reference group, the abortion rate was 15/100 births before the index date and 16/100 births after the index date.

Induced abortion indications varied slightly between the women with and without THR (Table 2).

More abortions were carried out due to maternal health reasons in the THR patient group. The rate of the first abortion was higher after THR compared with rates before the THR and the

reference group. Interestingly, married women seemed to have fewer abortions after THR than unmarried women.

Before the THR/index date there were 152 (14.1%) IAs among the THR patient group and 516 (12.8%) in the reference group, $p=0.25$. After the THR/ index date, the THR patient group had 35 (17.9%) IAs and the reference group 182 (13.9%), $p=0.17$. In the THR patient group, number of IAs varied from 152 (14.1%) before the THR to 35 (17.9%) after THR (PD= 3.5, CI -1.7 - 9.7). In the reference group, number of IAs before the index date were 516 (12.8%) and 182 after the index date (13.9%), PD= 1.1, CI -1.0 - 3.3. Median time after the THR to IA was 4.0 (range 0.1 to 20.4) years in the THR patient group and before the THR the median time from IA to THR was 8,4 years (0,2 to 20,5). Median times in the reference group were 3.9 years (0.0 to 19.7) after the index date, and 7.1 years (0.0 to 20.7) before the index date.

Women in the THR patient group were more likely to undergo their first IA after THR rather than before THR, or women in the reference group. Women in the youngest and the oldest age group had higher IA proportions than those in the moderate age groups (Table 3).

Unadjusted OR for pregnancy ending in induced abortion in the THR patient group after index date was 1.32 (CI 0.89 – 1.96), $p=0.17$, in relation to the reference group (Table 4). When adjusted with the variables of marital status, age (<20 or >39), previous IAs and previous deliveries, there was a trend for higher risk for pregnancy to end in IA in the THR group in relation to the reference group (OR was 1.50, CI 0.99 – 2.28; $p=0.05$).

Discussion

Our study showed no increase in the risk of pregnancy ending in induced abortion in women with THR compared with women in the reference group. When adjusting for available confounders, such as age, marital status, previous deliveries, and abortions, the risk for abortion was increased in relation to the reference group but remained non-significant. More abortions were carried out due to maternal health reasons in the THR patient group than in the reference group.

No differences in IA proportions between the groups were observed when the THR patients were compared with the referents. The IA proportions in all groups were similar to the overall national abortion proportion in 2015 (14.5%). IA rates in the THR patient group were lower compared with the reference group and national rates. This finding was due to the lower number of pregnancies per woman in the THR patient group. Our previous study showed that women have lower birth rates after THR (14).

Since no previous studies have analyzed the connection between THR and IA, we must evaluate the effect of other possible factors. Women with THR had lower SES than the referents. Low SES is a risk factor for induced abortion. Women with a lower educational level or income have a higher rate of IA when compared with women with a higher educational level and income (24, 25). The same effect was seen in our study population where blue-collar workers had higher IA numbers than persons with a higher SES. Although THR patients had lower SES, our study showed no increase in risk for IA in the THR group. However, the number of persons with missing information on SES was high in our study.

Previous IA was a high risk factor for IA in this study. Previous studies verify evidence on repeat IA, where the decision to have a second IA is easier after a previous IA (26). The incidence of repeated IAs is decreasing, however(27). After THR, women were more likely to have their first IA, which may indicate that THR might increase the IA risk.

In the THR patient group, there were more abortions both before and after THR due to maternal health indications than in the referents. Women with THR might have concerns about pregnancy, but the risk of IA was not increased (9). There is no evidence of THR complicating pregnancy or affecting pregnancy outcome (9, 10, 13). The THR patients might have had more baseline diseases compared with the referents. Some diseases are known to increase IA rates. For example, women using psychotropic medication or biological RA medication have increased abortion rates (28, 29). This finding could not, however, be identified in our present study due to the small incidences of chronic diseases (except RA) and the information on exact medications was not available.

This is the first study that has evaluated the relationship between THR and IA. One of the strengths of the study is the large, nationwide study population with long -follow-up. Our study also compares the IA rates before and after THR. Another strength of the study is the high quality of the register data (6, 23). Our study provides nationwide population-based findings that include a large and comprehensive study population of THR patients and the reference cohorts. Furthermore, the register-based approach eliminates possible recall-bias, i.e. possible previous IAs were identified from reliable registers, not with questionnaires.

Although the register data had high coverage and validity in most variables, information on SES was not fully available for this study. For example, data on the SES of only 34.1% of the participants were available. Moreover, even though the coverage was better in the MBR than in the RIA, it was still not possible to calculate reliable abortion ratios for each SES group or use them as a part of the logistic model. In addition, information on the marital status of the women at the exact time of the abortion was not available. Instead, we only had information on whether the women had ever been married.

Conclusions

Further studies are needed to confirm the clinical significance of these novel findings. This study shows that THR does not seem to be an independent risk factor for pregnancy ending in IA, although maternal health issues were a more common IA indication in the THR patient group. Further studies are needed to provide information on pregnancies and deliveries after THR.

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Declarations of Conflicting Interests

The authors declare no potential conflicts of interest with respect to the research, authorship, and publication of this article

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Table 1. Background characteristics of study population.

	Women with THR		Women without THR	
	n	%	n	%
	1713		5148	
Age at the start* of the abortion follow-up				
15-19	340	19.8	1017	19.8
20-24	353	20.6	1062	20.6
25-29	335	19.6	1009	19.5
30-34	361	21.1	1072	20.8
35-39	230	13.4	703	13.7
40-44	94	5.5	285	5.5
Age at THR/index date				
15-19	39	2.3	117	2.3
20-24	80	4.7	236	4.6
25-29	155	9.0	465	9.0
30-34	230	13.4	684	13.3
35-39	435	25.4	1310	25.4
40-44	774	45.2	2336	45.4
Marital status				
ever married	1238	72.3	4059	21.2
never married	475	27.7	1089	78.8
Nulliparous at the start of the abortion follow-up	979	57.2	2706	52.6
Follow-up time (years + SD)				
before THR/index date	9.8	5.9	9.8	5.9
after THR/index date	5.2	4.5	5.3	4.6
Chronic diseases				
Rheumatoid Arthritis	521	30.4	42	0.8
Diabetes Mellitus	28	1.6	33	0.6
Epilepsy	6	0.4	12	0.2
Major mental disease	3	0.2	8	0.2

THR= Total hip replacement

Index date= Date of the operation in the THR patient group and the same date for matching referents.

Start of the abortion follow-up= Day of the 15th birthday or 1st of January 1987, whichever came first.

Table 2. Total number of abortions for women with and without total hip replacement (THR) before and after THR/index date in Finland between 1987 and 2007.

	Women with THR				Women without THR			
	Before THR		After THR		Before the index date		After the index date	
	n	%	n	%	n	%	n	%
	152		35		516		182	
Previous pregnancies								
0	46	31.1	9	25.7	176	34.3	37	20.4
1+	102	68.9	26	74.3	337	65.7	144	79.6
Previous abortions								
0	95	63.8	28	80.0	340	66.3	115	63.5
1+	54	36.2	7	20.0	173	33.7	66	36.5
Previous births								
0	57	38.0	12	34.3	229	44.4	49	26.9
1+	93	62.0	23	65.7	287	55.6	133	73.1
Induced abortion indications								
social reasons	118	77.6	24	68.6	447	86.6	126	69.2
age*	5	3.3	4	11.4	31	6.0	23	12.6
Maternal health	17	11.2	5	14.3	14	2.7	5	2.7
Fetal health	6	3.9	1	2.9	13	2.5	12	6.6
over 4 previous births	6	3.9	1	2.9	11	2.1	16	8.8
Socioeconomic status								
upper white collar	1	2.7	3	16.7	14	8.7	20	21.1
lower white collar	19	51.4	6	33.3	57	35.4	38	40.0
blue collar	6	16.2	5	27.8	34	21.1	16	16.8
other**	11	29.7	4	22.2	36	22.4	21	22.1
Age at THR/index date								
under 20	0	0.0	4	11.4	3	0.6	15	8.2
20-24	4	2.6	4	11.4	35	6.8	27	14.8
25-29	16	10.5	3	8.6	58	11.2	45	24.7
30-34	30	19.7	12	34.3	100	19.4	37	20.3
35-39	35	23.0	9	25.7	117	22.7	43	23.6
40 or more	67	44.1	3	8.6	203	39.3	15	8.2
Age at the time of abortion								
under 20	12	7.9	1	2.9	49	9.5	5	2.7
20-24	29	19.1	4	11.4	105	20.3	13	7.1
25-29	40	26.3	4	11.4	119	23.1	30	16.5
30-34	37	24.3	5	14.3	136	26.4	40	22.0

35-39	29	19.1	13	37.1	79	15.3	58	31.9
40 or more	5	3.3	8	22.9	28	5.4	36	19.8
Marital status								
never married	51	33.6	12	34.3	159	30.8	46	25.3
ever married***	101	66.4	23	65.7	357	69.2	136	74.7
Rheumatoid arthritis								
no	131	86.2	24	68.6	509	98.6	182	100.0
yes	21	13.8	11	31.4	7	1.4	0	0.0

*age under 18 or over 40

**includes students and non-workers

***only the date of the first marriage is known. No information about divorces or new marriages.

Index date= Date of the operation in the THR patient group and the same date for matching referents

Table 3. Proportions of pregnancies ending in induced abortion with 95 % Confidence intervals (CI) among women with and without total hip replacement (THR) before and after THR/index date in Finland between 1987 and 2007.

	Women with THR				Women without THR			
	Before THR pregnancies		After THR pregnancies		Before the index date pregnancies		After the index date pregnancies	
	%	CI	%	CI	%	CI	%	CI
Previous pregnancies								
0	14.7	10.8 – 18.6	17.0	8.7 – 25.3	15.3	13.2 – 17.3	12.3	8.3 – 16.2
1+	13.5	11.1 – 15.9	17.8	11.8 – 23.8	11.8	10.7 – 13.0	14.4	12.0 – 16.7
Previous abortions								
0	11.0	8.9 – 13.1	16.2	10.8 – 21.6	10.2	9.1 – 11.2	10.7	8.7 – 12.6
1+	41.5	33.1 – 50.0	36.8	23.1 – 50.6	39.6	35.0 – 44.2	36.7	27.8 – 45.5
Previous births								
0	13.5	10.2 – 16.8	16.2	8.9 – 23.6	15.1	13.3 – 16.9	11.9	8.6 – 15.2
1+	14.4	11.7 – 17.1	18.4	11.9 – 24.9	11.6	10.3 – 12.8	14.9	12.4 – 17.4
Age at the time of abortion								
15-29	46.2	27.0 – 65.3	100.0	0.0 – 100.0	55.1	44.7 – 65.4	50.0	6.2 – 93.8
20-24	20.1	13.6 – 26.7	28.6	15.4 – 41.8	19.8	16.4 – 23.2	18.1	8.2 – 27.9
25-29	10.6	7.5 – 13.8	11.4	3.8 – 19.1	8.5	7.0 – 10.0	11.0	7.1 – 27.9
30-34	10.1	7.0 – 13.2	8.1	2.5 – 13.6	10.0	8.4 – 11.6	9.2	6.3 – 12.0
35-39	19.9	13.4 – 26.3	22.4	13.3 – 31.6	14.2	11.3 – 17.1	15.9	11.8 – 20.0
40-44	31.3	8.5 – 54.0	27.6	15.9 – 39.3	30.8	21.3 – 40.3	23.7	15.9 – 31.4
Marital status								
never married	31.5	24.5 – 38.9	38.7	25.7 – 51.7	28.3	24.6 – 32.0	19.5	13.9 – 25.1
ever married	11.1	9.0 – 13.1	13.7	8.7 – 18.7	10.3	9.3 – 11.3	12.7	10.6 – 14.8
Rheumatoid arthritis								
no	15.0	12.6 – 17.4	20.3	13.4 – 27.3	12.8	11.7 – 13.8	14.0	12.0 – 16.0
yes	10.4	6.2 – 14.7	13.6	7.0 – 20.1	17.1	5.6 – 28.6	0.0	0.0 – 0.0

Index date= Date of the operation in the THR patient group and the same date for matching referents

Table 4. Odds ratios (OR)s with 95 % Confidence intervals (CI) for pregnancy ending in induced abortion of women with total hip replacement (THR) in relation to the reference cohort of women without THR before and after THR/index date, Finland 1987-2007.

	Before the index date			After the index date		
	Univariate OR	95 % CI	p-value	univariate OR	95 % CI	p-value
THR patient group	1.12	0.92 – 1.36	0.25	1.32	0.89 – 1.96	0.17
Age*	5.51	4.16 – 7.29	<0.001	2.42	1.69 – 3.47	<0.001
Never married	3.50	2.91 – 4.23	<0.001	1.89	1.35 – 2.64	<0.001
Previous delivery	0.80	0.68 – 0.95	0.008	1.26	0.92 – 1.73	0.15
Previous abortion	5.79	4.76 – 7.04	<0.001	4.49	3.20 – 6.28	<0.001
Adjusted** OR for patient group	1.09	0.88 – 1.34	0.46	1.50	0.99 – 2.28	0.06

*age less than 20 or 40 or more

**adjusted by all variables above

Index date= Date of the operation in THR patient group and the same date for matching referents