ORIGINAL ARTICLE: SHORT COMMUNICATION

Patient characteristics of contraception and sterilization selection at vaginal delivery

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Objective: To examine patient characteristics among those who selected the long-acting reversible contraception (LARC) and surgical sterilization methods at vaginal delivery.
Design: Retrospective cohort study.
Setting: The National Inpatient Sample.
Patient(s): A total of 8,013,785 vaginal deliveries from October 2016 to December 2019.
Intervention(s): Exposure assignment per LARC (subdermal contraceptive implant [implants] or intrauterine device [IUD]) or surgical sterilization (bilateral salpingectomy [BS] or bilateral tubal ligation [BTL]) type.
Main Outcome Measure(s): Utilization trends of LARC or surgical sterilization, assessed with linear segmented regression with log-transformation, and differences in patient characteristics per the exposure strata (implants vs. IUD in the LARC group and BS or BTL in the surgical sterilization group), assessed using the multivariate binary logistic regression model.
Result(s): In a comparison between LARC and surgical sterilization, surgical sterilization use decreased from 1.90% to 1.55% (18.4% relative decrease), whereas LARC use increased from 0.35% to 1.02% (191% relative increase). In the LARC group, implant use (from 0.12% to 0.50%) increased more compared with IUD use (from 0.22% to 0.52%): relative increase, 317% vs. 136%. In the surgical sterilization group, BTL use decreased from 0.66% to 0.18% (72.7% relative decrease), whereas BS use was statistically unchanged (from 1.24% to 1.37%). In a multivariate analysis, recent year remained an independent characteristic for implant use in the LARC group and BS use in the surgical sterilization group. Moreover, in both LARC and surgical sterilization strata, procedure choices significantly differed on the basis of patient, pregnancy, hospital, and delivery factors.
Conclusion(s): Immediate postpartum contraception choice has evolved in recent years in the United States with an increasing demand for the LARC methods with implants at the time of vaginal delivery. (Fertil Steril Rep® 2022;■:■–■. ©2022 by American Society for Reproductive Medicine.)
Key Words: Vaginal delivery, long-active reversible contraception, surgical sterilization, trends, characteristics

Placement of long-acting reversible contraception (LARC) during hospital delivery is increasing in the United States (1, 2). Immediate postpartum LARC placement is associated with high rates of contraceptive satisfaction, continuation of the contraceptive method, and a lower risk of short interpregnancy interval (3, 4). A recent US study found a national-level increase in the use of LARC with either intrauterine device (IUD) or subdermal contraceptive implant (implants) between 2016 and 2018 (1). Furthermore, a decrease in the use of surgical sterilization with bilateral tubal ligation (BTL) at the time of delivery was noted during the same time period (1).

Given the national-level paradigm shift from surgical sterilization to LARC, clarifying the differences in patient characteristics among LARC (IUD or implants) and surgical sterilization (BTL or bilateral salpingectomy [BS]) types at vaginal delivery is of interest. This study aimed to examine patient characteristics associated with the

Received July 22, 2022; revised August 31, 2022; accepted September 2, 2022.
A.C.Y. has nothing to disclose. A.M.M. has nothing to disclose. H.E.S. has nothing to disclose. R.S.M. has nothing to disclose. J.G.O. has nothing to disclose. K.M. has nothing to disclose.
A.C.Y., A.M.M., and K.M. should be considered similar in author order.
Supported by Ensign Endowment for Gynecologic Cancer Research (to K.M.).
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Fertil Steril Rep® Vol. ■, No. ■, ■ 2022 2666-3341

https://doi.org/10.1016/j.xfre.2022.09.001

choice of the LARC and surgical sterilization methods in the immediate postpartum period after vaginal delivery.

MATERIALS AND METHODS

Data

The Healthcare Cost and Utilization Project's National Inpatient Sample was retrospectively queried (5). This program is a population-based all-payer database for hospital admission that randomly selects 20% of inpatient records in each participating center and the weighted data for national estimates represents >90% of the US population. The data set is both publicly available and deidentified, and this study was deemed exempt by the University of Southern California Institutional Review Board. The Strengthening the Reporting of Observational Studies in Epidemiology reporting guidelines were consulted for the cohort study (6).

Study Population

The study population was 8,013,785 vaginal deliveries from October 2016 to December 2019 for national estimates. Patients who underwent hysterectomy after delivery or those who had both LARC and surgical sterilization were excluded from analysis. The starting point was chosen owing to the introduction of the World Health Organization's International Classification of Disease 10th Revision codes for implants in the program for the exposure factors.

Exposure

Exposure allocation was per LARC (IUD or implants) or surgical sterilization (BTL or BS) type chosen. The IUD and implant cases were identified on the basis of the International Classification of Disease 10th Revision codes of Z30.430 and Z30.017, respectively. This study followed the same coding schema for identifying BTL (0U57, 0UL7, and 0UF7) and BS (0UB7 and 0UT7) (7).

Study Covariates

A total of 28 covariates were preselected and examined, including baseline demographics (age, year, admission type, race and ethnicity, primary expected payer, and census-level household income), comorbidity (obesity, tobacco use, grand multiparity, prior uterine scar, uterine myoma, diabetes mellitus, and hypertensive disease), pregnancy factors (multifetal gestation, fetal growth restriction, fetal demise, premature rupture of membrane, and chorioamnionitis), delivery data (gestational age, labor induction, operative delivery with vacuum-assisted or forceps delivery, manual placental removal, postpartum hemorrhage, and severe maternal morbidity per the Centers for Disease Control and Prevention definition), and hospital parameters (bed capacity, location/teaching setting, and region).

Outcome Measures

The primary outcome was the difference in patient characteristics in each exposure strata, comparing IUD vs. implants in the LARC group and BTL vs. BS in the surgical sterilization group, assessed by a multivariate logistic regression model. The effect size was expressed with the adjusted odds ratio and corresponding 95% confidence interval. The co-outcome measures included temporal trends of surgical sterilization and LARC over time, assessed with linear segmented regression with log-transformation (year-quarter increments).

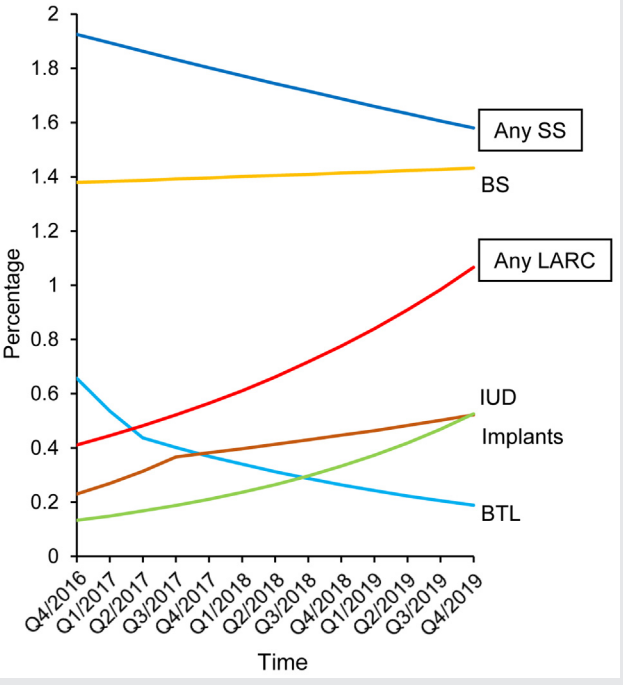
RESULTS

Trends

In a comparison between LARC and surgical sterilization, the number of patients receiving any surgical sterilization decreased from 1.90% to 1.55% (18.4% relative decrease, P trend$<$.001), whereas that of patient with LARC placement increased from 0.35% to 1.02% (191% relative increase, P trend$<$.001) during the study period (Fig. 1).

Among the LARC types, the number of patients receiving implants (from 0.12% to 0.50%, P trend$<$.001) as well as IUD (from 0.22% to 0.52%, P trend$<$.001) both increased during the study period; however, the interval increase was higher for implant placement than for IUD (relative increase, 317%

FIGURE 1



Temporal trends of LARC and surgical sterilization (SS) at vaginal delivery. A total of 8,013,785 vaginal deliveries from October 2016 to December 2019 for national estimates were examined. The temporal trends of any SS (blue) and any LARC (red) are shown (year-quarter increments). In the LARC types, the trends of IUD (brown, n = 32,210) and subdermal contraceptive implant (implants) (light green, n = 23,035) are shown. In the SS types, the trends of BTL (light blue, n = 27,585) and BS (yellow, n = 112,510) are shown. Modeled values based on linear segmented regression with log-transformation (year-quarter increments).
BS = bilateral salpingectomy; BTL = bilateral tubal ligation; IUD = intrauterine device; LARC = long-acting reversible contraception.

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TABLE 1

Results of the multivariate analysis.

	Implants vs. IUD		BS vs. BTL	
Characteristic	**aOR (95% CI)**	***P* value**	**aOR (95% CI)**	***P* value**
Age (y)	0.97 (0.96–0.97)	<.001	1.01 (1.01–1.01)	<.001
Year				
Q4/2016	0.97 (0.88–1.08)	.583	0.57 (0.54–0.59)	<.001
2017	1		1	
2018	1.33 (1.26–1.40)	<.001	1.44 (1.39–1.49)	<.001
2019	1.85 (1.76–1.94)	<.001	1.95 (1.88–2.02)	<.001
Admission type				
Nonelective	1		1	
Elective	0.89 (0.86–0.93)	<.001	1.02 (0.99–1.05)	.215
Unknown	0.90 (0.60–1.37)	.626	2.34 (1.46–3.74)	<.001
Race/ethnicity				
Black	1		1	
White	0.80 (0.76–0.85)	<.001	0.95 (0.91–0.99)	.017
Hispanic	1.32 (1.26–1.39)	<.001	1.03 (0.98–1.08)	.201
Asian	1.26 (1.13–1.39)	<.001	1.37 (1.23–1.52)	<.001
Native American	1.37 (1.16–1.62)	<.001	1.24 (1.07–1.43)	.003
Others	0.80 (0.73–0.87)	<.001	0.97 (0.89–1.05)	.406
Unknown	1.34 (1.20–1.50)	<.001	0.81 (0.75–0.88)	<.001
Primary expected payer				
Medicaid	1		1	
Private including HMO	0.55 (0.52–0.58)	<.001	1.04 (1.01–1.08)	.007
Medicare	0.84 (0.72–0.98)	.028	1.39 (1.21–1.59)	<.001
Self-pay	1.06 (0.95–1.18)	.333	1.03 (0.93–1.14)	.535
No charge	0.73 (0.44–1.19)	.203	2.86 (1.49–5.48)	.002
Others	1.20 (1.01–1.43)	.036	0.83 (0.75–0.91)	<.001
Unknown	3.09 (1.89–5.06)	<.001	3.51 (2.06–5.99)	<.001
Median household income				
QT1 (lowest)	1		1	
QT2	1.02 (0.98–1.07)	.331	1.13 (1.09–1.17)	<.001
QT3	0.81 (0.77–0.85)	<.001	1.20 (1.15–1.25)	<.001
QT4 (highest)	0.67 (0.63–0.72)	<.001	1.28 (1.21–1.35)	<.001
Unknown	1.03 (0.84–1.27)	.750	1.18 (1.03–1.35)	.015
Hp bed capacity				
Small	3.00 (2.81–3.20)	<.001	1	
Mid	1.56 (1.49–1.63)	<.001	1.00 (0.96–1.04)	.976
Large	1		1.16 (1.12–1.20)	<.001
Hp location/teaching				
Rural	1.58 (1.33–1.87)	<.001	0.60 (0.58–0.63)	<.001
Urban nonteaching	1		1	
Urban teaching	1.08 (0.99–1.18)	.067	1.14 (1.10–1.18)	<.001
Hp region				
Northeast	0.50 (0.47–0.53)	<.001	1.01 (0.95–1.06)	.777
Midwest	0.56 (0.53–0.60)	<.001	1.29 (1.23–1.35)	<.001
South	1.02 (0.96–1.07)	.603	1.10 (1.05–1.14)	.201
West	1		1	
Obesity				
No	1		1	
Yes	0.79 (0.75–0.83)	<.001	1.10 (1.05–1.14)	<.001
Grand multiparity				
No	1		1	
Yes	1.18 (0.88–1.58)	.259	0.64 (0.59–0.70)	<.001
Tobacco use				
No	1		1	
	1.31 (1.23–1.40)	<.001	1.04 (0.99–1.08)	.118
Prior uterine scar				
No	1		1	
Yes	0.83 (0.77–0.90)	<.001	1.04 (0.98–1.11)	.163
Uterine myoma				
No	1		1	
Yes	0.73 (0.59–0.91)	.005	1.28 (1.06–1.54)	.010
Diabetes mellitus				
No	1		1	
Pregestational	1.00 (0.87–1.17)	.957	1.01 (0.89–1.15)	.844
Gestational	0.94 (0.87–1.02)	.124	1.01 (0.97–1.06)	.571

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TABLE 1

Continued.

	Implants vs. IUD		BS vs. BTL	
Characteristic	**aOR (95% CI)**	***P* value**	**aOR (95% CI)**	***P* value**
Hypertensive disease				
No	1		1	
Pregestational	0.81 (0.74–0.88)	<.001	0.95 (0.88–1.01)	.115
Gestational	0.95 (0.89–1.02)	.133	0.98 (0.92–1.04)	.476
Multifetal gestation				
No	1		1	
Yes	0.71 (0.59–0.85)	<.001	1.40 (1.20–1.64)	<.001
Fetal growth restriction				
No	1		1	
Yes	1.10 (1.01–1.2)	.026	1.14 (1.04–1.24)	.003
Intrauterine fetal demise				
No	1		1	
Yes	1.39 (1.10–1.75)	.006	1.14 (0.79–1.65)	.480
Premature rupture of membrane				
No	1		1	
Preterm	1.05 (0.94–1.17)	.393	1.18 (1.05–1.32)	.005
Term	0.99 (0.92–1.06)	.739	1.27 (1.17–1.37)	<.001
Chorioamnionitis				
No	1		1	
Yes	2.87 (2.52–3.26)	<.001	2.18 (1.67–2.85)	<.001
Gestational age at delivery				
≥39	1		1	
37–38	1.16 (1.11–1.21)	<.001	0.97 (0.94–0.99)	.030
34–36	1.22 (1.13–1.31)	<.001	0.97 (0.91–1.03)	.314
<34	1.64 (1.46–1.84)	<.001	0.94 (0.83–1.06)	.316
Unknown	0.54 (0.43–0.67)	<.001	0.96 (0.85–1.08)	.499
Labor induction				
No	1		1	
Yes	0.86 (0.83–0.90)	<.001	1.04 (1.01–1.07)	.035
Operative delivery				
No	1		1	
Forceps	1.75 (1.46–2.10)	<.001	1.02 (0.84–1.24)	.840
Vacuum-assisted	1.18 (1.07–1.30)	.001	0.89 (0.83–0.96)	.001
Manual removal				
No	1		1	
Yes	1.30 (1.10–1.54)	.002	1.09 (0.91–1.30)	.355
Postpartum hemorrhage				
No	1		1	
Yes	1.52 (1.40–1.65)	<.001	1.19 (1.10–1.30)	<.001
Severe maternal morbidity				
No	1		1	
Yes	0.97 (0.83–1.13)	.667	1.40 (1.18–1.65)	<.001

Note: A binary logistic regression model was used for the multivariate analysis. The initial covariate selection was $P<.05$ in the univariate analysis. The parsimonious conditional backward method was used for the final modeling. aOR = adjusted odds ratio; BS = bilateral salpingectomy; BTL = bilateral tubal ligation; CI = confidence interval; HMO = health maintenance organization; Hp = hospital; implant = subdermal contraceptive implant; IUD = intrauterine device.

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vs. 136%; Fig. 1). In the fourth quarter of 2019, the number of patients receiving IUD only marginally exceeded that of patients with implants (0.52% and 0.50%, respectively).

Among the surgical sterilization types, the number of patients undergoing BTL decreased from 0.66% to 0.18% (72.7% relative decrease, *P* trend< .001), whereas that of patients undergoing BS were unchanged from 1.24% to 1.37% (*P* trend= .298; Fig. 1).

Across the 4 exposure groups, nearly 1 in 30 patients who had a vaginal delivery received any 1 of these 4 procedures in the last year quarter of 2019 (3.34%), and the most frequent procedure was BS (1.37%), followed by IUD placement (0.52%), implant placement (0.50%), and BTL (0.18%).

Patient Characteristics

In the LARC group, 32,120 patients who received IUD and 23,035 patients who received implants were compared (Table 1). When compared with patients who received IUD, patients who received implants were more likely to be younger; have a recent year delivery; be a tobacco user; have chorioamnionitis, fetal growth restriction/demise, preterm delivery, operative delivery, manual placental removal, and postpartum hemorrhage; and have delivered at small rural hospitals; however, they were less likely to be obese and Hispanic; have higher household income, private insurance, pregestational hypertension, prior uterine scar and uterine myoma, multifetal gestation, elective admission for delivery,

and labor induction; and have delivered at centers at the Northeast and Midwest regions (all, $P<.05$).

In the surgical sterilization group, 112,510 patients who underwent BS and 27,585 patients who underwent BTL were compared (Table 1). When compared with patients who underwent BTL, patients who underwent BS were more likely to be older; have a recent year delivery; be obese; have higher household income, uterine myoma, premature rupture of membrane, chorioamnionitis, multifetal gestation, fetal growth restriction, labor induction, postpartum hemorrhage, and severe maternal morbidity; and have delivered at large urban hospitals in the Midwest regions; however, they were less likely to be grand multiparity and have a vacuum-assisted delivery (all, $P<.05$).

DISCUSSION

Findings

The present study adds more detailed information to the recent US national-level observation of a shift from surgical sterilization to LARC in that this shift is mainly because of the decrease in BTL procedures and increase in implant placements (1). The observed temporal trend projects that the number of patients receiving LARC will likely exceed that of patients receiving surgical sterilization by the first quarter of 2021 and that in the LARC group, the number of patients receiving implants will likely exceed that of patients receiving IUD by the first quarter of 2020.

Even in the same treatment category of LARC, there was substantial variability in the patient choice between IUD and implants on the basis of patient, pregnancy, delivery, and hospital factors. This also applied to surgical sterilization cases between BS and BTL. Taken together, these data suggest that increasing accessibility to all LARC and surgical sterilization methods is useful for shared decision-making between providers and patients.

Although the absolute percentage rate of BS was unchanged, because of the decrease in BTL use, there was a relative increase in BS use over time that this association was independent after controlling other factors including hospital parameters (Table 1). This nationwide paradigm shift from BTL to BS was also reported in cesarean deliveries and benign hysterectomies (7, 8). It is most likely that consensus for opportunistic salpingectomy for ovarian cancer risk reduction may change the landscape of surgical sterilization in both obstetric and gynecologic surgeries.

Limitations

The limitations of the present study include the unmeasured bias with the lack of information on the exact reason for procedure selection, patient and physician's knowledge and experience, routine prenatal care, hospital practice, home delivery, patient satisfaction, quality-of-life measures, regret, and long-term complications. Lower likeliness of implant placement vs. IUD placement in uterine myoma also suggests a possible unmeasured confounder effect, warranting further investigation.

Accuracy of data, particularly for the BTL and BS procedures, was not assessable because actual medical record review was not performed. Ascertainment bias because of the data capturing schema in the program and generalizability to other populations are also recognized as possible limitations of this study. Despite these limitations, the results of this study suggest that the immediate postpartum contraception choice at vaginal delivery has evolved in recent years in the United States.

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