Original Study

Intrauterine Devices: Effective Contraception with Noncontraceptive Benefits for Adolescents

Oluyemisi A. Adeyemi-Fowode MD, Jennifer L. Bercaw-Pratt MD *

Department of Obstetrics and Gynecology, Baylor College of Medicine, Houston, Texas

A B S T R A C T

Although adolescent pregnancy and birth rates have been declining since the early 1990s, the rate of intrauterine device (IUD) use in adolescents remain low. IUDs are a highly effective contraceptive method with a failure rate of less than 1%. There are currently 5 IUDs available and marketed in the United States: the nonhormonal copper-containing IUD (Paragard Copper T380A; Ortho-McNeil) and 4 hormonal levonorgestrel-releasing intrauterine systems (LNG-IUDs). IUDs can be used in adolescents, and the LNG-IUD has many noncontraceptive benefits including the treatment of heavy menstrual bleeding, dysmenorrhea, pelvic pain/endometriosis, and endometrial hyperplasia/endometrial cancer. In addition, the LNG-IUD is an effective tool for suppression of menses.
Key Words: Intrauterine devices, Adolescents, Contraception

Introduction

Although adolescent pregnancy and birth rates have been declining since the early 1990s and reached historic lows at 22.3 per 1000 women aged 15-19 years in 2015, the United States continues to have the highest adolescent pregnancy and birth rates among developed countries.[1,2] Seventy-five percent of pregnancies among US adolescents are unplanned and represent 15% of all unintended pregnancies annually.[3] The proportion of women at risk of unintended pregnancy who are not using a contraceptive method is highest among those ages 15-19 years.[4] Because of the high risk of unintentional pregnancy, adolescents need highly effective contraceptive methods. Long-acting reversible contraceptive (LARC) refers to methods of contraception that are effective for an extended period of time and do not require user action. It includes the subdermal implant and intrauterine devices (IUDs). IUDs have high efficacy, continuation rates, and satisfaction rates that make them an ideal option for adolescents.[4] Despite their proven safety, efficacy, and cost-effectiveness, few adolescents use the IUD for contraception. Data from the 2011-2015 National Health Statistics Report on contraceptive use among adolescents ages 15-19 years revealed that 2.8% have used the IUD compared with the 2006-2010 data that showed that 2.5% have ever used the IUD.[2]

IUD Types

Five IUDs are currently available and marketed in the United States: the nonhormonal copper-containing IUD (Paragard, Ortho-McNeil; Cu T380A) and 4 hormonal levonorgestrel-releasing IUDs (LNG-IUDs). The American College of Obstetricians and Gynecologists supports use of IUDs in adolescents regardless of parity, and the US Medical Eligibility Criteria for Contraceptive Use classifies IUD use in nulliparous women as category 2; a condition for which the advantages of using the method generally outweigh the theoretical risks.[3,5] Table 1 shows the characteristics, doses, efficacy, and amenorrhea rates for all 5 IUDs currently in use in the United States.[3,6–10]

The copper IUD, Cu T380A, is a T-shaped polyethylene device with copper wire wrapped around the stem and both arms of the frame. It was the first of the currently available IUDs introduced in the United States. As the only nonhormonal IUD, the copper IUD is an ideal option for patients who wish to avoid hormones or desire continued cyclic menses.[11] A unique advantage of the copper IUD is its ability to provide emergency contraception for up to 5 days after unprotected sex.[12,13]

There are currently 4 LNG-IUDs available and approved by the US Food and Drug Administration (FDA). These include the Mirena (Bayer), Skyla (Bayer), Liletta (Allergan), and Kyleena (Bayer). All are T-shaped and include a polydimethylsiloxane sleeve that contains levonorgestrel on the stem.[14] Each LNG-IUD releases a different amount of levonorgestrel per day with the dose decreasing over the life of the device.[7–10] The LNG-IUDs with lower doses of levonorgestrel (Skyla and Kyleena [both from Bayer]) have overall lower systemic exposure to levonorgestrel compared with the Mirena (Bayer).[15] Levonorgestrel in serum is primarily protein-bound and is extensively metabolized to a large number of inactive metabolites. The elimination half-life of levonorgestrel is less than 24 hours; the parent drug and its metabolites are primarily excreted in the urine.[7] Metabolic clearance rates might differ among individuals by several-fold, and this might account in part for wide individual variations in levonorgestrel concentrations noted in users.[7]

The authors indicate no conflicts of interest.

This article is published as part of a supplement supported by an educational grant from Bayer HealthCare Pharmaceuticals Inc. This, and the other articles in this supplement, have been reviewed using the same criteria as that applied to all Journal of Pediatric and Adolescent Gynecology submissions.

* *Address correspondence to:* Jennifer L. Bercaw-Pratt, MD, 6651 Main St, Suite 1050, Houston, TX 77030; Phone: (832) 826-7464; fax: 832-825-9349

E-mail address: jbercaw@bcm.edu (J.L. Bercaw-Pratt).

1083-3188/$ - see front matter
https://doi.org/10.1016/j.jpag.2019.07.001

Table 1
Characteristics of IUDs*

	Paragard	Mirena	Skyla	Liletta	Kyleena
FDA approval	1984	2000	2013	2015	2016
Active Ingredient	Copper 380-mm wire	Levonorgestrel	Levonorgestrel	Levonorgestrel	Levonorgestrel
Size in mm (width × height)	32 × 36	32 × 32	28 × 30	32 × 32	28 × 30
Width of applicator	4.0 mm	4.4 mm	3.8 mm	4.4 mm	3.8 mm
Recommended uterine size*	Sound to 6-9 cm. Risks increase with >10 cm†	Sound to 6-10 cm	N/A	Sound to ≥5.5 cm. Risk increase with <5.5 cm†	N/A
Dosage of levonorgestrel	N/A	52 mg	13.5 mg	52 mg	19.5 mg
Daily Rate of levonorgestrel	N/A	20 μg/d	14 μg/d	19.5 μg/d	17.5 μg/d
Length of use	10 Years	5 Years	3 Years	5 Years	5 Years
Effectiveness‡	0.80	0.20	0.30	0.20	0.30
Amenorrhea at 1 year	N/A	20%	6%	19%	12%
Identifying characteristics[3]	White strings	Gray strings	Gray strings; silver ring seen on imaging	Blue strings	Blue strings; silver ring seen on imaging

FDA, US Food and Drug Administration; IUD, intrauterine device; N/A, not applicable.
Paragard from Cooper Surgical (Trumbull, CT); Mirena, Skyla, and Kyleena from Bayer (Whippany, NJ); and Liletta from Allergan (Irvine, CA).
* Information was collected via each device's prescribing information handout.
† Risks include increased risk of expulsion, bleeding, pain, perforation, and failure of method.
‡ Effectiveness was reported as the Pearl Index (number of pregnancies per 100 woman-years).

All currently available IUDs are radiopaque. Ultrasound is the most common initial imaging modality used for evaluation of IUDs because of its cost-effectiveness, lack of ionizing radiation, and greater detail of pelvic anatomy.[16] The stem is usually easily identified as a linear echogenic structure.[16] Although the arms of the copper IUD are fully echogenic, the arms of LNG-IUDs are only echogenic at the proximal and distal ends.[16] When the IUD cannot be located using pelvic ultrasound examination, abdominal radiographs can be used to evaluate IUD positioning.

Mechanism of Action

Despite decades of study, the precise mechanism of action for IUDs remains unclear and is complex.[17] All types of IUDs cause endometrial changes that are spermicidal, inhibiting sperm migration through the endometrium.[18,19] In the LNG-IUDs, there is decidualization and atrophy of the endometrial glands, which leads to reduced sperm capacitation and survival but might also inhibit implantation of the fertilized ovum.[18] LNG-IUDs also cause thickening of the cervical mucus, which inhibits the passage of sperm through the cervix.[19,20] In general, IUDs do not effectively suppress ovulation.[19] IUDs do not disrupt pregnancy and are not abortifacient.[14]

Efficacy

IUDs are highly effective contraception with failure rates similar to that of permanent sterilization.[14] With typical use, the copper IUD has a failure rate of 0.8 per 100 women at 1 year. Similarly, with typical use, the LNG-IUDs have a failure rate of between 0.2 and 0.3 per 100 women at 1 year.[7–10]

Although the FDA-approved duration of IUD use varies from a range of 3-10 years depending on the type used (Table 1), it appears that they can be efficacious past the approved number of years. Available data support contraceptive effectiveness of the Mirena (Bayer) for up to 7 years and the copper IUD for up to 12 years.[21–23] The original FDA-approved duration of use for the Liletta (Allergan) was 3 years in 2016; however, with the ongoing phase III study, it was recently expanded to 5 years in 2018.[14]

Continuation

Adolescents have high continuation rates with LARC methods such as IUDs and contraceptive implants. Studies among adolescents and young women younger than 25 years of age, reveal a 12-month continuation rate of 81%-88% among LARC users with data specific to IUDs lacking.[24–28] In addition, the continuation rates for IUDs were higher than for other non–long-acting contraception methods such as oral contraceptives and depot medroxyprogesterone acetate injections.[26] The Contraceptive CHOICE Project, a prospective cohort study of women 14-45 years of age in the St Louis region who initiated a new form of reversible contraception reported 62% of adolescents chose a LARC method, of the younger adolescents ages 14-17 years, 63% chose the subdermal implant whereas in older adolescents ages 18-20 years, 71% chose an IUD.[11] This project also noted that 66% of nulliparous participants aged 14-19 years were using their LARC method at 24 months with again specific data for IUDs missing.[28]

High satisfaction rates are reported in studies of the copper IUD and the LNG-IUDs. Among women enrolled in the Contraceptive CHOICE Project, 85% of LNG-IUD users, and 80% of copper IUD users were very or somewhat satisfied at 12 months.[29] A prospective study of 109 nulliparous students age 18-30 years at a university health clinic showed that 83% of users were happy or very happy with either the copper IUD or LNG-IUDs, and 87% reported they were likely or very likely to recommend to a friend.[30]

Safety

IUD use in adolescents has very low rates of complications such as uterine perforation and pelvic inflammatory disease.[3] A systematic review showed 4 retrospective cohort studies with a very low rate of uterine perforation in 0.1% of adolescents and young women using the copper IUD or LNG-IUDs.[31] The risk of pelvic inflammatory disease with IUD

placement is 0%-2% when no cervical infection is present, and 0%-5% when insertion occurs with an undetected infection.[32] Sexually active adolescents should be screened for gonorrhea and chlamydial infection at the time of insertion to decrease this risk.[3] Finally, infertility is not more likely to occur after IUD use than other types of contraception as shown in the Contraceptive CHOICE Project in which there was no difference in pregnancy rates or time to pregnancy between the different types of contraceptive groups.[33]

Adverse Effects

IUDs can be associated with several adverse effects such as changes in menstrual bleeding pattern, pelvic pain, IUD expulsion, and progesterone hormone-related effects such as acne, headaches, nausea, breast tenderness, and mood changes.[7] It is important to counsel adolescents with regard to the possibility of these adverse effects.

All available IUDs can be associated with changes in menstrual bleeding pattern. For the LNG-IUD, there can be an increase in irregular or prolonged spotting during the first 90 days of use but this tends to decrease over time.[14] Adolescents using LNG-IUDs will also have a decrease in bleeding over time that will lead to overall lighter bleeding, spotting, or amenorrhea.[3] In the first year of use, 20% of women will experience amenorrhea and within the first 2 years, more than 50% might experience amenorrhea or oligomenorrhea.[34] It is especially important to reiterate this with adolescents and mention that devices with lower total and daily doses of levonorgestrel will have lower rates of amenorrhea and also might have higher rates of unscheduled bleeding (Table 1).[3]

The copper IUD is more likely to be associated with heavy menstrual bleeding (HMB) and cramping compared with the LNG-IUD.[30] A prospective survey of 109 nulliparous women aged 18-30 years who had an IUD placed at a student health clinic noted that users of the Cu T380A were more likely to experience HMB and cramping compared with LNG-IUD users.[30] Another prospective cohort study included 281 women who were 13-19 years of age compared with 571 women who were 20-30 years of age in which adolescents using the copper IUD were noted to have higher rates of pain, bleeding, displacement, expulsion, and removal than the adult women.[35] Thus despite the copper IUD's high contraceptive efficacy, the LNG-IUD might be more acceptable in this population because of its more favorable menstrual bleeding pattern. Still, the copper IUD is ideal for adolescents with a personal preference for a nonhormonal option or desired continued cyclic menses.

Pelvic pain is another adverse effect reported in IUD users.[36] In a survey of 132 women using long-acting reversible contraceptives, pelvic pain was associated with a higher rate of IUD discontinuation.[37] Similarly, in a retrospective cohort study of 307 adolescent IUD users, pelvic pain was associated with a higher rate of IUD discontinuation.[38]

IUD expulsion rates ranges from 2% to 10% for all IUD users.[39] In a large prospective study of 1117 adolescents who underwent IUD placement at a university clinic, there was an expulsion rate of 3.0% at 6 months after placement.[39] This is consistent with other studies that support that younger women are not more likely to experience expulsion than older women.[3] It is important to remember that the adolescent who has experienced an IUD expulsion should be counseled that there is an increased risk of recurrence of approximately 30%.[3]

Limited studies have been completed that evaluated for the development of ovarian cysts with IUD use. The contraceptive effect of LNG-IUDs is mainly due to local effects within the uterus, thus ovulatory cycles with follicular rupture might occur in women of reproductive age using IUDs.[7,19] A phase III study investigated ovarian cysts with screening transvaginal ultrasound examination during the first year of use of the Skyla (Bayer) IUD in healthy women with regular cycles. The prevalence of ovarian cysts before placement of the IUD was 1.6% and increased to 2.0%-2.4% during the first year of use. In all patients who were followed for the full year of the study, 100% of the cysts resolved without any intervention.[40] Similarly, a prospective randomized controlled trial that compared LNG-IUD use vs hysterectomy for the treatment of abnormal uterine bleeding noted that ovarian cysts were more common among the women randomized to the LNG-IUD compared with hysterectomy with prevalence rates of 21.5% and 8%, respectively, in the first year. Again, it was noted that 94% of the cysts resolved spontaneously within the next 6 months.[41] On the basis of these limited studies, it appears that the prevalence of ovarian cysts might increase with LNG-IUD use but in most cases these cysts will resolve spontaneously with observation and are unlikely to be of clinical significance.[40,41]

Similar very limited evidence exists on the effects of LNG-IUDs on acne with currently no clinical studies directly addressing this common complaint. Review of current case reports and available studies does favor a flare in acne with LNG-IUD use.[42]

Contraindications

The Centers for Disease Control and Prevention has developed evidence-based guidance for contraceptives, the US Medical Eligibility Criteria for Contraceptives Use that providers can reference during counseling of adolescents.[5] Contraindications for IUD placement in adolescents are the same as for adult women. Anatomical concern or an active symptomatic infection with gonorrhea/chlamydia or pelvic inflammatory disease is a reason to avoid placement.[19]

Noncontraceptive Benefits

IUDs, specifically the Mirena (Bayer), have been shown to have benefits beyond their contraceptive effectiveness. These noncontraceptive benefits include the treatment of HMB, dysmenorrhea, pelvic pain/endometriosis, and endometrial hyperplasia/endometrial cancer. In addition, the LNG-IUD is an effective tool for suppression of menses.[43,44] Although studies about these noncontraceptive benefits have been mostly conducted with adult subjects, the available evidence suggests similar benefits in adolescents.[45]

HMB can affect up to 40% of adolescents, which has been shown to have a significant effect on the quality of life of affected adolescents.[46,47] The first landmark study on the use of the LNG-IUD for the treatment of HMB was published in Sweden in 1990. The investigators followed 20 women who had objective HMB (more than 80 mL per month). Participants' menstrual cycles were monitored for 2 months before placement of the LNG-IUD then at 3, 6, and 12 months after placement. Over the first year, there was a statistically significant increase in the serum ferritin levels of participants. In addition, the participants' menstrual blood loss was reduced by 86% at 3 months and 97% by 12 months.[48] Further studies have continued to verify that the LNG-IUD is an effective tool for the treatment of HMB. A Cochrane systematic review in 2015 showed that the LNG-IUD was more effective in decreasing menstrual blood loss, improving the user's quality of life, and having a higher continuation rate after 2 years than compared with oral hormonal agents.[49]

Among adolescents with HMB, up to 20% are found to have an underlying bleeding disorder.[46] Some of the common bleeding disorders include von Willebrand disease, platelet function defects, thrombocytopenia, and clotting factor deficiencies. Despite limited evidence in this clinical situation, LNG-IUDs are often used in women with bleeding disorders to treat HMB. There are multiple small case series supporting the safety and effectiveness of the LNG-IUD in the treatment of HMB in patients with an underlying bleeding disorder.[50–52]

Dysmenorrhea is the most common menstrual symptom among adolescents. The prevalence rates vary but range from 50% to 90%.[53] Dysmenorrhea is the leading cause of recurrent short-term school absenteeism for female adolescents.[53] Primary dysmenorrhea accounts for most causes of dysmenorrhea and is associated with normal cycles with no pelvic pathology. The LNG-IUD has been shown to be effective in the treatment of dysmenorrhea although limited studies with a focus on primary dysmenorrhea exist. One study of 200 women aged 18-25 years who sought contraception were randomized to either combined oral contraceptive pills or the LNG-IUD. The LNG-IUD was shown to be more effective in the treatment of dysmenorrhea than the combined oral contraceptive pill with women reporting a decrease of dysmenorrhea by 18.3%.[54]

Most studies of the LNG-IUD have been focused on secondary dysmenorrhea due to endometriosis. Endometriosis is the leading cause of secondary dysmenorrhea in adolescents.[53] Although the true prevalence of endometriosis is unknown, approximately two-thirds of adolescents with pelvic pain or dysmenorrhea in whom non-steroidal anti-inflammatory drugs and hormonal therapies have failed will be diagnosed with endometriosis at the time of diagnostic laparoscopy.[53] In fact, the American College of Obstetricians and Gynecologists recommends that a LNG-IUD be considered for placement at the time of diagnostic laparoscopy for dysmenorrhea or pelvic pain in adolescents as an effort to avoid the pain associated with insertion in the office.[53] A recently published randomized clinical trial of 103 women with chronic pelvic pain and dysmenorrhea due to endometriosis compared the LNG-IUD with the etonogestrel-releasing contraceptive implant. The study showed a significant improvement in chronic pelvic pain with LNG-IUD use; the pain score (on the basis of the visual analogue scale) decreased from 7.4 to 1.9 over 180 days; similarly, an improvement in dysmenorrhea with LNG-IUD use was seen—the pain score decreased from 7.3 to 1.9 over 180 days. The study concluded that the LNG-IUD significantly improved pelvic pain, dysmenorrhea, and quality of life in endometriosis.[55] A recent meta-analysis concluded that the LNG-IUD was as effective in pain relief as gonadotropin-releasing hormone analogues and prevented recurrent dysmenorrhea postoperatively in women with diagnosed endometriosis.[56]

More than one-third of adolescents in the United States are overweight or obese.[57] Obese women are at increased risk for menstrual disorders and polycystic ovarian syndrome due to chronic anovulation and endometrial stimulation.[45] In addition, obesity is a well known risk factor for the development of endometrial hyperplasia and endometrial cancer. Although rare, there have been several case reports of endometrial hyperplasia with atypia and endometrial cancer occurring in adolescents and young women.[58] A mainstay of the treatment of menstrual cycle disorders resulting from obesity is endometrial protection. In a recent meta-analysis a cure rate with LNG-IUD of 76% in women with complex endometrial hyperplasia with atypia or early endometrial cancer was reported, reconfirming that the LNG-IUD is an effective option for endometrial protection and even treatment of endometrial hyperplasia and cancer.[59] Although specific data on the use of LNG-IUDs in obese adolescents for uterine protection and treatment of endometrial hyperplasia and cancer are sparse, some limited studies have shown promise.[45] This possible benefit must be balanced with the lack of effectiveness of the LNG-IUD for the treatment of acne and hirsutism in adolescents with polycystic ovarian syndrome.

Finally, there are several medical conditions in which minimizing the blood loss associated with menses each month might benefit the adolescent. In addition, adolescents with physical disabilities or intellectual disabilities might benefit from menstrual suppression with regard to hygiene and behavioral concerns. The LNG-IUD has been shown to be effective for menstrual suppression in these situations.[60]

Conclusion

IUDs are a highly effective option for contraception in adolescents with multiple noncontraceptive medical benefits.

References

1. Finer LB, Zolna MR: Declines in unintended pregnancy in the United States, 2008-2011. N Engl J Med 2016; 374:843
2. Abma JC, Martinez GM: Sexual activity and contraceptive use among teenagers in the United States, 2011-2015. Natl Health Stat Rep 2017; 1
3. ACOG Committee Opinion No. 735: adolescents and long-acting reversible contraception: implants and intrauterine devices. Obstet Gynecol 2018; 131: e130

4. Guttmacher Institute: Contraceptive use in the United States. Available: https://www.guttmacher.org/fact-sheet/contraceptive-use-united-states. Accessed January 10, 2019.
5. Curtis KM, Tepper NK, Jatlaoui TC, et al: U.S. medical eligibility criteria for contraceptive use, 2016. MMWR Recomm Rep 2016; 65:1
6. Paragard [package insert]. Trumbull, CT, Cooper Surgical, 2018
7. Mirena [package insert]. Whippany, NJ, Bayer, 2017
8. Skyla [package insert]. Whippany, NJ, Bayer, 2018
9. Liletta [package insert]. Irvine, CA, Allergan, 2018
10. Kyleena [package insert]. Whippany, NJ, Bayer, 2018
11. Schmidt E, James A, Curran K, et al: Adolescent experiences with intrauterine devices: a qualitative study. J Adolesc Health 2015; 57:381
12. ACOG Practice Bulletin No. 152: emergency contraception. Obstet Gynecol 2015; 126:e1
13. Goldstuck N, Wildemeersch D: Practical advice for emergency IUD contraception in young women. Obstet Gynecol Int 2015; 2015:986439
14. ACOG Practice Bulletin No. 186: long-acting reversible contraception: implants and intrauterine devices. Obstet Gynecol 2017; 130:18
15. Apter D, Gemzell-Danielsson K, Hauck B, et al: Pharmacokinetics of two low-dose levonorgestrel-releasing intrauterine systems and effects on ovulation rate and cervical function: pooled analyses of phase II and III studies. Fertil Steril 2014; 101:1656
16. Nowitzki K, Hoimes M, Chen B, et al: Ultrasonography of intrauterine devices. Ultrasonography 2015; 34:183
17. Rivera R, Yacobson I, Grimes D: The mechanism of action of hormonal contraceptives and intrauterine contraceptive devices. Am J Obstet Gynecol 1999; 181:1263
18. Stanford J, Mikolajczyk R: Mechanism of action of intrauterine devices: update and estimation of postfertilization effects. Am J Obstet Gynecol 2002; 187:1699
19. Francis J, Gold M: Long acting reversible contraception for adolescents: a review. JAMA 2017; 171:694
20. Mishell D: Intrauterine devices: mechanisms of action, safety, and efficacy. Contraception 1998; 58:45S
21. Sivin I, Stern J, Coutinho E, et al: Prolonged intrauterine contraception: a seven-year randomized study of the levonorgestrel 20 μg/day (LNG 20) and the Copper T380 Ag IUDS. Contraception 1991; 44:473
22. Rowe P, Farley T, Peregoudov A, et al: Safety and efficacy in parous women of a 52-mg levonorgestrel-medicated intrauterine device: a 7-year randomized comparative study with the TCu380A. Contraception 2016; 93:498
23. Wu JP, Pickle S: Extended use of the intrauterine device: a literature review and recommendations for clinical practice. Contraception 2014; 89:495
24. Secura GM, Allsworth JE, Madden T, et al: The contraceptive CHOICE project: reducing barriers to long-acting reversible contraception. Am J Obstet Gynecol 2010; 203:115.e1
25. Diedrich JT, Klein DA, Peipert JF: Long-acting reversible contraception in adolescents: a systematic review and meta-analysis. Am J Obstet Gynecol 2017; 216:364.e1
26. Usinger KM, Gola SB, Weis M, et al: Intrauterine contraception continuation in adolescents and young women: a systematic review. J Pediatr Adolesc Gynecol 2016; 29:659
27. Rosenstock JR, Peipert JF, Madden T, et al: Continuation of reversible contraception in teenagers and young women. Obstet Gynecol 2012; 120:1298
28. Abraham M, Zhao Q, Peipert JF: Young age, nulliparity, and continuation of long-acting reversible contraceptive methods. Obstet Gynecol 2015; 126:823
29. Peipert JF, Zhao Q, Allsworth JE, et al: Continuation and satisfaction of reversible contraception. Obstet Gynecol 2011; 117:1105
30. Hall AM, Kutler BA: Intrauterine contraception in nulliparous women: a prospective survey. J Fam Plann Reprod Health Care 2016; 42:36
31. Jatlaoui TC, Riley HEM, Curtis KM: The safety of intrauterine devices among young women: a systematic review. Contraception 2017; 95:17
32. Mohllajee A, Curtis K, Peterson HB: Does insertion and use of an intrauterine device increase the risk of pelvic inflammatory disease among women with sexually transmitted infection: a systematic review. Contraception 2006; 73: 145
33. Stoddard A, Xu H, Madden T, et al: Fertility after intrauterine device removal: a pilot study. Eur J Contracept Reprod Health Care 2015; 20:223
34. Villavicencio J, Allen RH: Unscheduled bleeding and contraceptive choice: increasing satisfaction and continuation rates. Open Access J Contracept 2016; 7:43
35. Rasheed SM, Abdelmonem AM: Complications among adolescents using copper intrauterine contraceptive devices. Int J Gynaecol Obstet 2011; 115:269
36. Howard B, Gubb E, Lage M, et al: Trends in use of and complications from intrauterine contraceptive devices and tubal ligation or occlusion. Reprod Health 2017; 14:70
37. Dickerson L, Diaz V, Jordon J, et al: Satisfaction, early removal, and side effects associated with long-acting reversible contraception. Fam Med 2013; 45:701
38. Bayer L, Jensen J, Li H, et al: Adolescent experience with intrauterine device insertion and use: a retrospective cohort study. Contraception 2012; 86:443
39. Teal S, Romer S, Goldthwaite L, et al: Insertion characteristics of intrauterine devices in adolescents and young women: success, ancillary measures, and complications. Am J Obstet Gynecol 2015; 213:515.e1
40. Nahum GG, Kaunitz AM, Rosen K, et al: Ovarian cyst: presence and persistence with use of a 13.5 mg levonorgestrel releasing intrauterine system. Contraception 2015; 91:412
41. Inki P, Hurskainen R, Palo P, et al: Comparison of ovarian cyst formation in women using the levonorgestrel releasing intrauterine system versus hysterectomy. Ultrasound Obstet Gynecol 2002; 20:381
42. Bosanac SS, Trivedi M, Clark AK, et al: Progestins and acne vulgaris: a review. Dermatol Online J 2018; 24:1
43. Sergison JE, Maldonado LY, Gao X, et al: Levonorgestrel intrauterine system associated amenorrhea: a systematic review and meta-analysis. Am J Obstet Gynecol 2019; 220:440
44. Baldaszti E, Wimmer-Puchinger B, Loschke K: Acceptability of the long-term contraceptive levonorgestrel-releasing intrauterine system (Mirena): a 3-year follow-up study. Contraception 2003; 67:87
45. Bayer LL, Hillard PJ: Use of levonorgestrel intrauterine system for medical indications in adolescents. J Adolesc Health 2013; 52(4 suppl):S54
46. Haamid F, Sass AE, Dietrich JE: Heavy menstrual bleeding in adolescents. J Pediatr Adolesc Gynecol 2017; 30:335
47. Nur Azurah AG, Sanci L, Moore E, et al: The quality of life of adolescents with menstrual problems. J Pediatr Adolesc Gynecol 2013; 26:102
48. Andersson JK, Rybo G: Levonorgestrel-releasing intrauterine device in the treatment of menorrhagia. Br J Obstet Gynaecol 1990; 97:690
49. Lethaby A, Hussain M, Rishworth JR, et al: Progesterone or progestogen-releasing intrauterine systems for heavy menstrual bleeding. Cochrane Database Syst Rev 2015; 4:Cd002126
50. Lukes AS, Reardon B, Arepally G: Use of the levonorgestrel-releasing intrauterine system in women with hemostatic disorders. Fertil Steril 2008; 90:673
51. Adeyemi-Fowode OA, Santos XM, Dietrich JE, et al: Levonorgestrel-releasing intrauterine device use in female adolescents with heavy menstrual bleeding and bleeding disorders: single institution review. J Pediatr Adolesc Gynecol 2017; 30:479
52. Lu M, Yang X: Levonorgestrel-releasing intrauterine system for treatment of heavy menstrual bleeding in adolescents with Glanzmann's thrombasthenia: illustrated case series. BMC Womens Health 2018; 18:45
53. ACOG Committee Opinion No. 760: dysmenorrhea and endometriosis in the adolescent. Obstet Gynecol 2018; 132:e249
54. Suhonen S, Haukkamaa M, Jakobsson T, et al: Clinical performance of a levonorgestrel-releasing intrauterine system and oral contraceptives in young nulliparous women: a comparative study. Contraception 2004; 69:407
55. Carvalho N, Margatho D, Cursino K, et al: Control of endometriosis-associated pain with etonogestrel-releasing contraceptive implant and 52-mg levonorgestrel-releasing intrauterine system: randomized clinical trial. Fertil Steril 2018; 110:1129
56. Song SY, Park M, Lee GW, et al: Efficacy of levonorgestrel releasing intrauterine system as a postoperative maintenance therapy of endometriosis: a meta-analysis. Eur J Obstet Gynecol Reprod Biol 2018; 231:85
57. Hawkins DR, Kazmierski K, Hansen A, et al: Trends in weight loss efforts among US adolescents with overweight and obesity. JAMA Pediatr 2018; 172:782
58. Elizondo-Montemayor L, Hernandez-Escobar C, Lara-Torre E, et al: Gynecologic and obstetric consequences of obesity in adolescent girls. J Pediatr Adolesc Gynecol 2017; 30:156
59. Wei J, Zhang W, Feng L, Gao W: Comparison of fertility-sparing treatments in patients with early endometrial cancer and atypical complex hyperplasia: a meta-analysis and systematic review. Medicine 2017; 96:e8034.
60. Pradhan S, Gomez-Lobo V: Hormonal contraceptives, IUDs, GnRH analogues and testosterone: menstrual suppression in special populations in this supplement). J Pediatr Adol Gynecol 2019. Supplement.