REVIEW ARTICLE

Current Concepts in Contraception

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ABSTRACT

Background: *Worldwide, contraceptive use has increased substantially over the past two decades. The increased demand for wider choices of contraceptive methods has resulted in extensive research and rigorous clinical trials. This has led to improvements on existing contraceptive methods and also the development of several new, more effective and acceptable methods with fewer side effects. Thus, this article presents a review of existing literature on recent developments on existing contraceptive methods. It also reviews recently developed contraceptive methods currently in use worldwide.*

Methods: *Relevant literature was reviewed using manual library search, electronic sources such as CD-ROMS and internet articles.*

Conclusion: *More effective methods of contraception which are generally safer and easier to administer are increasingly being developed. Hopefully, as they increasingly become available in our environment, they will lead to and increase in acceptance and use of contraception by our women.*

KEY WORDS: Current concepts; Contraception; Hormonal methods; Non-hormonal methods.

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INTRODUCTION

Contraception has been described as one of the greatest advances of the twentieth century and in the past two decades its use has increased substantially worldwide [12]. This has been much more striking in the developing world where contraceptive prevalence rose from 9% in the 1960s to 60% in 1997 [1]. Demographic and health estimates have shown that the proportion of women using modern contraceptive methods in Nigeria has increased from 3% in 1990 [2] to 8% in 2003 [3]. Better access to family planning information and services, improvement in the social and economic status of women within the household and an increase in the formal education of women has led to the increased demand for contraception and a subsequent increase in contraceptive use among our women [2].

To further increase contraceptive use rates, extensive research and rigorous clinical trials have resulted in improvements on existing contraceptive methods and also the development of several more effective and less expensive contraceptives that are easier to deliver and cause fewer side effects than currently available options[4]. This article thus focuses on recent developments of existing contraceptive methods and also reviews recently developed methods currently in use worldwide.

HORMONAL METHODS

Combined Oral Contraceptives (COCs)

These are tablets that contain a combination of oestrogen and progestin and are taken daily. Though they act primarily by suppressing ovulation, they also thicken cervical mucus thus making it impervious to sperm and alter the uterine endometrium [5,6]. They are safe, very effective when used consistently and accurately with a failure rate of 0.1 in 100 pregnancies in the first year of use [6]. Currently, the development of low dose formulations has led to a reduction in the side effects of COCs including venous thrombosis and myocardial infarction [6,7]. Thus, most low dose pills in use today contain 35micrograms (ug) or less of oestrogen and 400ug or less of progestin [7]. Third generation COC pills containing the progestins norgestimate, desogestrel and gestodene designed to reduce safety risks and side effects have also been introduced and are now first choice oral contraceptives in most developed countries [8]. These, while giving good cycle control, are less androgenic and therefore tend to be better for women who have problems with acne, hirsutism and weight gain; minor side effects which have been shown to greatly influence compliance [9,10]. COCs normalize menstrual bleeding, abolish primary dysmenorrhoea and prevent the development of pelvic inflammatory disease (PID) and benign breast disease [6,11]. They also strongly protect against endometrial and ovarian cancer, with protection continuing for 10-15 years after discontinuation and with longer duration of use offering greater protection [11].

i) **Drospirenone combined oral contraceptive**

The COC Yasmin contains 30ug of ethinyl estradiol and 3mg of the new progestin drospirenone [4]. It is about as effective as other COCs in the first year of use[12]. In addition to preventing pregnancy, the other benefits drospirenone provide for some women include reduction in acne and hirsutism [12]. Clinical trials

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have also found that Yasmin causes less water retension and thus less fluid related weight gain than other COCs [13].

Progesterone Only Methods

Progesterone only methods of contraception that were introduced to avoid the side effects of oestogens are becoming increasing popular. All progestogen only methods act locally on the cervical mucus and the uterine endometrium thereby preventing sperm transport and implantation [14]. Higher dose progestins also inhibit ovulation [14].

ii) **Progesterone only injections**

These are very effective, safe, convenient for most users, very easy for providers to deliver, can be self administered, can also be distributed easily in non-clinical settings by non-physicians and its administration ensures compliance [14]. The two main progestin only injectables are depotmedroxy progesterone acetate (DMPA) and norethisterone enanthate [14]. DMPA, which is administered intramuscularly at a dose of 150 milligrams (mg) every 12-calendar weeks, is far more widely used [8,15]. It is one of the most effective methods of contraception (pregnancy rate 0.3 pregnancies/ 100 women in the first year of use) with an efficacy equal to that of female sterilization [16]. Proper counselling is important before administration as disturbances of menstruation may occur which may be marked and unpredictable. Also, though reversible, there is usually a median delay in return of fertility of six months (not including the duration of the last injection) [8]. DMPA reduces the incidence of endometrial and ovarian cancers, ectopic pregnancy, iron deficiency anaemia and PID [17]. It is the ideal contraceptive for sicklers and epileptics as it prevents sickling of cells thus reducing sickling crisis [18] and also reduces the frequency of seizures in epileptics [19].

iii) **Subdermal Implants**

Norplant comprises of six 3 centimetre (cm) silastic capsules each containing 36 milligrams (mg) of levonorgestrel (LNG), which is inserted into the non-dominant upper arm under local anaesthesia [20,21]. Approximately 30ug/day of LNG is released and it provides excellent contraceptive protection for 5 years (failure rate = 0.1 pregnancies/100 women in first year of use) [8] with no compliance required by the user. However, it is associated with bleeding disturbances, which have led to high discontinuation rates in some countries [22]. Hence, new generation implants designed to make insertion and removal much easier, with more effectiveness and fewer complications, and with less discomfort for users have been developed and are now in use in the developed world. These include Jadelle (formerly known as Norplant 2); an implant containing two 4 cm levonorgestrel releasing rods with effectiveness for 5 years and Implanon; a reversible single rod containing etonogestrel effective for 3 years [8,20]. Jadelle though easier to insert and remove, delivers the same daily dose of LNG that Norplant delivers and its side effects, continuation rates and contraceptive effectiveness are similar to Norplant's [23]. Implanon however does not require a skin incision and releases 30-40ug of 3-ketodesogestrel (etonogestrel) per day [8]. This hormonal level is designed to achieve complete inhibition of ovulation and so far there has not been a single pregnancy reported with its use [24]. Implanon is the only contraceptive to have a pearl index of zero and return of fertility after removal of an implanon implant is prompt, as studies have shown return of ovulation within 6 weeks [24].

iv) **Desogestrel Progestin-only Contraception**

These pills each contain 75ug of desogestrel, which are taken daily [25]. Unlike other progestin only pills (POPs) that work primarily on the cervical mucus, desogestrel is unique in that it acts primarily by preventing ovulation and also, a pill can be taken as much as 12 hours late without reducing its effectiveness [26].

Combined Oestrogen/Progesterone Injectables

Cyclofem, a combination of medroxy-progesterone acetate (25mg) and oestradiol cypionate (5mg) and Mesigna (norethisterone 50mg and oestradiol valerate 5mg) are new injectable contraceptives that are administered monthly and provide effective contraception mainly by inhibiting ovulation [27]. They have been shown to have first year failure rates of 0.1-0.4/100 women years [27]. Compared to progestin-only injectables, not only is there far less menstrual disturbance as bleeding tends to occur predictably once a month after the first few months of use, but there is also an earlier return of ovulation after women discontinue their use [27]. Hence, women who stop using combined injectables can become pregnant as soon as

6 weeks after their last injection. However lack of access to these remains a major problem, as many women are unable to return to their providers every month for their injections.

Emergency Contraception (Post Coital Contraception)

This is a safe and effective way of preventing unwanted pregnancy after unprotected intercourse or condom accident [28]. The three effective methods currently used worldwide are the combined hormonal emergency contraception (the Yuzpe regimen), progesterone only emergency contraception using LNG (marketed as postinor II) and copper intrauterine contraceptive device (Cu IUCD) insertion [1]. Both hormonal emergency contraceptives are licensed for use up to 72 hours following the first act of unprotected sexual intercourse [28]. However, because LNG emergency contraceptive pills cause less nausea and vomiting and are also more effective in preventing pregnancy (prevent 85% of expected pregnancies when taken correctly) when compared to the combined formulation, they are now currently recommended as first choice emergency contraceptives [29,30]. Also a single dose of 1.5ug of LNG instead of two doses 0.75ug 12 hours apart, which was previously recommended is now the preferred regimen as this has been shown to increase compliance [31]. However, the most effective emergency contraceptive remains the insertion of a Cu IUCD (failure rate < 1%) [8,28]. This has the greatest flexibility in terms of timing and can be fitted up to five days after the earliest predicted date of ovulation regardless of how many times unprotected intercourse has occurred [8]. Since progesterone is known to play a role in the establishment of pregnancy, the anti-progesterone Mifepristone (RU 486) is being tested as an emergency contraceptive [1]. Available information suggests that a single dose of 10mg taken within 5 days of unprotected intercourse has an efficacy of 85% and fewer side effects than the Yuzpe regime [32]. Gestrinone, a trienic 19 nor-steriod with anti-progestational, anti-estrogenic and androgenic properties used for the treatment of endometriosis is also being evaluated [1].

Vaginal Rings

Steroid hormones are released from silastic vaginal rings and are efficiently absorbed through the vaginal epithelium [1]. They are highly effective (effectiveness 1.2-1.5/100 women in the first year as typically used), easily inserted, checked, removed and replaced by the user [1]. They are not coitally related and provide a constant rate of drug release. Upon removal, plasma hormone levels return to normal and fertility rapidly returns. Each ring is worn for three weeks in a row, and then discarded. After a ring free week for menses, the client starts a new ring. Rings come as combined formulations (Nuva ring which releases 120ug of etonogestrel and 15ug of ethinyl estradiol per day) and progestin only formulations (Progering which releases 10mg of natural progesterone per day) [23].

Transdermal Contraceptive Patches.

These deliver hormones continuously through the skin into the blood stream and like vaginal rings, have the advantage of avoiding first pass through the liver thereby reducing the metabolic effects of the exogenous steroids [1]. The only contraceptive patch currently available is OrthoEvra [23]. It can be applied to the abdomen, upper torso, upper outer arm or buttocks and it delivers 150ug of the progestin norelgestromin and 20ug of ethinyl estradiol per day [23]. It provides effectiveness (0.1-0.3 pregnancies/100 women in the first year as typically used) and cycle control similar to COCs [23]. A single patch is worn for one week, discarded and replaced with a new one. Three weeks of use is followed by a patch free week to allow for menses [23]. The most commonly reported side effects associated with its use are skin irritation or rash at the site of application affecting about 2% of users [33].

Male Hormonal Methods

Hormonal contraception for men work by inhibiting sperm production using either testosterone or a combination of testosterone and a progestin or a Gonadotrophin releasing hormone analogue (GnRH) [1]. It is rapidly reversible as discontinuation of treatment leads to full recovery of gonadotrophin secretion and spermatogenesis [1]. Combined regimens of testosterone and a progestin offer the most promise [1]. A number of clinical trials have proven the feasibility and contraceptive efficacy of this approach [1]. Current research is focusing on the development and use of more potent and longer acting steroids [1].

B. NON-HORMONAL METHODS

Intra-Uterine Contraceptive Devices

i) **The Copper bearing devices**

Copper (Cu) containing medicated devices are the most widely used IUCDs. Of these, the CuT380, which offers 10 years of protection against pregnancy and has one of the lowest failure rates, is the gold standard [34]. The addition of Cu improves

efficacy, enabling the development of smaller IUCDs with fewer side effects [20]. They also provide contraception as effective as that offered by the COC pills (annual failure rate 0.4/100 women) [35]. The earlier assumption that their major mechanism of action was to prevent implantation of the developing embryo is now known to be erroneous [36]. IUCDs are now known to prevent pregnancy by interfering with the ability of sperm to survive and ascend the fallopian tubes thus preventing fertilization [36]. However, concerns about their relationship with pelvic infection have been a feature throughout the history of the IUCD and remain the most important negative perception about its use. Previous observational studies had strongly suggested a causal association between IUCD use and increased tubal disease [37]. However, most recent data on IUCD use and the risk of pelvic infection are generally more reassuring. Large randomised controlled trials from around the world have shown low rates of PID associated with IUCD use [38]. If an IUCD user is within a monogamous relationship and has no past history of PID, then the excess risk of PID with an IUCD is minimal. The risk of acute PID in IUCD users is largely confined to the first few weeks following insertion, presumably from direct introduction of organisms into the upper genital tract [36].

ii) **The Intrauterine System**

The development of levonorgestrel IUCD as an intrauterine system has resulted in a contraceptive with better efficacy and numerous non-contraceptive benefits [39]. It releases 20ug of LNG daily and is effective for five years [23,.34]. It is as effective as female sterilization (pregnancy rate 0.1/100 women in first year of use) [34]. Once the LNG IUCD is removed, fertility returns promptly as 90% of women become pregnant within the first year after removal of their IUCDs [34]. It substantially reduces menstrual blood loss unlike Cu IUCDs and hence is now licensed for use in some developed countries as treatment for menorrhagia [40]. It protects against the development of fibroids and ectopic pregnancy and can also be used with oestrogen replacement therapy during the menopause to protect the endometrium [34,39].

iii) **The Frameless IUCD (Gynefix)**

The Gynefix is a novel, frameless device that has six copper beads wound around a monofilament polypropylene thread [34]. It is designed to try and overcome the problems of expulsion, heavy bleeding and increased dysmenorrhoea associated with the use of conventional framed devices [8]. It is licensed for 5 years and studies to date have shown a failure rate of 0.5/100 women years and expulsion rates less than 1/100 woman years [8]. Although there are limited data available, it appears that bleeding and dysmenorrhoea may be reduced compared to conventional IUCDs [41]. This may make it preferable for nulliparous women, as well as those who experience problems with pain or expulsion with previous IUCDs [8]. However, it should only be inserted by those who have received appropriate training, as its insertion technique is quite different to that of conventional IUCDs [34].

iv) **Other new IUCDs**

a) **The Cu Safe 300**

In order to facilitate easier and less painful insertions and removals, and further reduce the risk of expulsion, a smaller and lighter T-shaped Cu IUCD with flexible uniquely shaped arms- the Cu Safe 300 has been developed [42]. Its insertion requires neither plunger nor sterile gloves and with a diameter of 3.0mm, the inserter is about one third smaller than that of the Cu T 380A IUCD which makes the Cu Safe easy to insert and remove [43]. The Cu Safe carries a recommend life span of 5 years [42]. Studies have indicated pregnancy rates of 0.6/100 women at one year of use and one year continuation rates of 89% [44].

b) **The Fincoid- 350**

The Finciod 350 is also designed to resist accidental expulsion [43].It has a plastic skeleton comprised of curved horizontal arms and a Cu-coated vertical stem [43]. The horizontal arms lock into a groove on the vertical stem and the resultant moveable joint easily contracts and expands with uterine contractions adjusting to variations in uterine size and shape [42].Studies indicate continuation rates of 90%, pregnancy rates of 0.6%, expulsion rates of 3.7% and rate of removals for pain and bleeding of 2.6% [42,43].

c) **The Intracervical fixing device (ICFD)**

The ICFD differs substantially in both construction and placement from other IUCDs

[43]. It consists of a rod-shaped, Cu-coated polyethylene frame that is about 4cm long with a 5mm projection at the distal end [42]. The ICFD is anchored to the inner cervical wall through its projection using a modified tenaculum and its removal is facilitated by grasping the stem with sponge forceps [42]. Its potential advantages are that the insertion procedure is not blind and due to its intracervical location, it will likely be associated with less spotting, bleeding and pain [45].

d) **The Sof-T**

The Sof-T is a Cu IUCD with a unique shape to enhance effectiveness [46]. It has soft flexible knobs or occlusion bodies on each of its flexible transverse arms which theoretically block the entrances into the fallopian tube [43]. Its insertion procedure is similar to that of currently available Cu IUCDs [43]. However, two dimensional ultrasound scan (USS) must be used to ensure exact placement of the device [46]. Studies indicate annual expulsion rates ranging between 0.3%-3.5%, removals for pain or bleeding ranging 0%-1.4% and Pearl index ranging from 0%-1.3% [45].

e) **The Multiload Mark 11 (MM11)**

The MM11 has a 375mm^2 Cu coated shaft and was developed to overcome the insertion limitations associated with the original Multiload 375 [42]. It has shorter, more flexible arms that allow the device to be folded completely into the inserter [43]. The design of the inserter also prevents the IUCD from getting pushed beyond the inserter [43]. In addition, the inserter can function as a uterine sound and has a one handed expulsion action all of which limit the risk of uterine perforation [45]. Few data are however currently available on the device's effectiveness or its effect upon ease of insertion.

Barrier Methods

These work by preventing sperm cells from reaching the female cervix. To be most effective, they should be used during every act of intercourse and also used correctly as incorrect or in-consistent use are often the causes of barrier method failure. These are the only contraceptive methods that have been shown to protect against STIs including HIV.

i) **Male Condoms**

This remains one of the most popular methods of contraception [47]. There are cheap, widely available and virtually free of side effects [47]. Most condoms are made of latex [48]. However, the recently introduced plastic (polyurethane) condom "Avanti" is thinner, odour free, stronger, less allergenic, confers better sensation and fits more comfortably than the latex condom [20,23]. Also, they have a longer shelf life and can be used with oil-based lubricants, which damage latex condoms [48]. However, though they are as effective as the latex condom in preventing pregnancy, recent studies have indicated higher breakage and slippage rates during intercourse and withdrawal [48].

ii) **The Female Condom**

a) **The FC Female Condom (FC1)**

The FC1 formerly called Reality is made of polyurethane plastic that is sturdier than the male latex condom and offers less frequent breakage and improved comfort [20]. Though pre-lubricated, it can be used with any type of lubricant without compromising its strength. It can be inserted hours before intercourse and is therefore less likely than the male condom to reduce sexual spontaneity [49]. Failure rates are similar to that of the male latex condom [20]. It is however expensive and still has not become popular [20].

b) **The FC2 Female Condom**

This is a second generation female condom which appears identical to the FC1 but is made of synthetic latex [50]. Though currently undergoing clinical trials, its performance and acceptability is comparable to the FC1 and it is expected to be cheaper [50].

c) **The VA Feminine Condom**

This is also known as the Reddy female condom and as V-Armour. It is a one-size device which is made of latex. It uses a polyurethane sponge to aid insertion and there is a firm outer ring intended to hold it in place during intercourse [50]. It is cheaper than FC1 and currently available in some African countries [50].

d) **The Natural Sensation Panty Condom (NSPC)**

The NSPC made of polyethylene resin, is a reusable thong panty with replaceable

condoms [50]. The condom is inserted by the man's penis and the panty itself can be reused with another condom for additional acts of intercourse [51]. It is unlike any other condom designed for women, and is easy to use, can be worn all day and does not lead to an interruption in the natural progression of the sexual act [51].

lii) **Lea's Shield**

This is a one-sized cup shaped washable and reusable vaginal barrier contraceptive device made of medical grade silicone rubber [52]. It is primarily designed for use with a spermicide which should be placed around the rim of the shield before insertion [53]. Unlike the cervical cap and diaphragm, it is held in place by the vaginal walls and there is an air flow valve which allows air that is trapped between the cervix and the device to escape [53]. This acts as a seal between the shield and the vagina ensuring the device stays in place during intercourse [53]. It should remain in place for at least 8 hours after intercourse and can be left up to 40 hours after insertion [52]. It offers several advantages over existing female barrier methods as latex allergy is not a concern, it comes in one size only simplifying the fitting process and additional spermicidal jelly is not required for each repeated act of intercourse [54]. It is generally as effective as other barrier birth control options as reports indicate a failure rate about 12% per year when used consistently and 8% per year when used with a spermicide [54].

STERILIZATION

This is an operation aimed at permanent occlusion of the passages that convey the male or female gametes and remains the most globally used method of contraception.

i) **Female Sterilization**

This involves blocking the fallopian tubes to prevent pregnancy [20]. This can safely be performed as an interval procedure (any time after 6 weeks post delivery) or as post partum sterilization (within one week, preferably 48 hours of delivery or concurrently with Caesarean section) [55]. Sterilization is most commonly performed by laparoscopy or minilaparotomy (minilap) [56]. Laparoscopic sterilization is more commonly performed in the developed world except when sterilization is performed in the immediate post-partum when the uterus is large, the fallopian tubes are enlarged, the pelvis is very vascular and hence the risk of laparoscopy is increased [20], and also when the abdomen has multiple abdominal scars from previous abdominal operations [56]. In the developing world, where laparoscopic equipment and the necessary skill and experience required to perform these are not readily available, minilap is the technique of choice for sterilization. The most commonly used method for tubal occlusion during laparotomy and minilap is the Pomeroy technique[57]. This is as a result of its simplicity and effectiveness[57]. Laparoscopic sterilization is most commonly performed by applying rings (Falope rings) or clips (Hulka- Clemens or Filshie clips) [56]. Laser and electrocautery can also be used [56].

ii) **Newer Approaches to Female Sterilization**

a) **Essure**

This is a microcoil consisting of 2 wire and fibre devices, each of which is inserted through the cervix and uterine cavity into the entrance of each fallopian tube using a hysteroscope [58]. Once inserted, scar tissue grows into the devices, blocking the fallopian tubes permanently [59]. Its primary advantages are that it can be performed under local anaesthesia (LA) and does not require cutting into the abdominal cavity thereby reducing the risk of infection, bleeding and other complications [58]. It appears to be as effective as female sterilization once inserted.

b) **Quinacrine**

This is a chemical compound in the form of pellets that produces scarring to block the fallopian tubes resulting in permanent sterilization when inserted into the uterus [58].Its safety and precise effectiveness is still being investigated [58].

c) **The Adiana Procedure**

Here, a clinician passes a catheter through a hysteroscope and uses the catheter to apply low radio-frequency energy creating a superficial lesion [58]. A porous plastic implant is then placed into the lesion following which surrounding tissue grows into it over the next 12 weeks resulting in total occlusion of the fallopian tubes [58]. Clinical studies are still ongoing to determine its effectiveness.

li) **Male Sterilization**

Vasectomy involves the division of the vas deferens on each side to prevent the passage of sperm during ejaculation [20]. It is easier, quicker, associated with fewer complications than female sterilization and is usually performed under local anaesthesia [1]. However the need for a skin incision and lack of assured reversibility appears to be the main issues limiting its acceptability [1]. Hence, two techniques, which have been developed to overcome these problems, are the no-scalpel method of vasectomy and percutanous non-surgical vas occlusion techniques using percutanous injections of liquid silicone or insertion of silicone plugs [60].

Microbicides

These are substances that are designed when applied vaginally or rectally to prevent transmission of HIV and other STIs [61]. Some microbicides under development also function as spermicides to provide contraceptive protection [1].Most microbicides under development either act as vaginal defence enhancers, surfactants, entry and fusio; jkn inhibitors or replication inhibitors [61].

Immunological Methods

Clinical observations have suggested that the presence of antisperm antibodies might be a cause of infertility [1]. Studies to identify appropriate antigens have focused on at least four classes of targets [1]. Thus, antibodies have been raised against GnRH, the gonadotrophins and their testicular receptors, sperm specific proteins and epididymal proteins [1]. Trials using GnRH, gonadotrophins or their receptor proteins as antigens demonstrate some promise [1]. Research to identify appropriate adjuvants and immunization protocols in order to produce consistent immune responses, reliable sperm suppression or an acceptable decrease in fertility is ongoing [1].

Fertility Awareness Based Methods (FABMs)

FABMs are those methods that depend upon a woman identifying those days during each menstrual cycle when intercourse is most likely to result in pregnancy. Two new variations of FABMs, the standard day's method (SDM) and the two day method (TDM) help women keep track of their fertile days [62]. The SDM is based on the timing of the fertile window during the woman's menstrual cycle and strings of colour coded beads called cycle beads that represent a woman's menstrual cycle are used to indicate the fertile period [62]. On the other hand, the TDM is based on the presence or absence of cervical secretions [63]. Clinical trials of both methods have indicated typical use pregnancy rates of about 12-14 pregnancies per 100 women in one year of use [63].

CONCLUSION

More effective contraceptive methods, which are also generally safer and easier to administer are increasingly being developed. Hopefully, as they increasingly become available in our environment, they will lead to an increase in acceptance and use of contraception by our women.

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