

# Barrier Contraceptives and the Interaction Between HIV and Other Sexually Transmitted Diseases

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Acquired immune deficiency syndrome (AIDS) and infection with the human immunodeficiency virus (HIV) constitute a worldwide public health problem. AIDS epidemics in Europe, most of North and South America, and Asia predominantly have been in homosexual men and intravenous drug abusers. In Africa, the pattern of transmission is primarily heterosexual, with perinatal transmission an increasingly important mode of spread. The groups at greatest risk of HIV infection are urban prostitutes, their male clients, and other men and women with multiple sexual partners. Studies in Nairobi [1-4] have shown that sexually transmitted diseases (STDs) and other risk factors play an important role in HIV infection in both men and women. These findings have been corroborated by studies [5] in the United States. The interaction between STDs and HIV infection is one reason accounting for the high prevalence of infection in prostitutes and other persons who exhibit high-risk sexual behavior. In the absence of a vaccine for HIV infection and of a cure for AIDS, behavior change—reducing the number of sexual partners and using effective contraception, including condoms—is seen as the most feasible way to reduce sexual transmission of HIV infection. Promoting the use of condoms already is the mainstay of AIDS intervention programs.

Several issues about the association between contraception and HIV infection have arisen. Although it makes intuitive sense that

condoms would protect against HIV just as they protect against other STDs, the epidemiological evidence for protection against HIV is inadequate, and even less evidence supports the effectiveness of spermicides in preventing HIV transmission.

Of equal importance is whether any method of contraception increases a person's risk of acquiring HIV infection. One study [4] indicated that oral contraceptive use by prostitutes may enhance the risk of acquired HIV infection. Until additional data are available on the interaction between hormonal contraceptives and HIV infection, conclusions cannot be drawn.

This chapter examines evidence about the interaction between HIV and other STDs and about the effectiveness of condoms and spermicides in preventing STDs and HIV infection. Recommendations also are made about the research needed to fill our knowledge gaps.

### INTERACTION BETWEEN HIV AND OTHER STDs

Evidence shows that the presence of some STDs, especially genital ulcer disease caused by chancroid, syphilis, and herpes, increases the risk of acquiring HIV infection [6–8]. Earlier studies had not determined whether this association is causal or merely that genital ulcers correlate with a large number of sexual partners. A prospective study [4] of seronegative prostitutes from Nairobi that controlled for number of sexual partners, duration of prostitution, and use of condoms found that the presence of genital ulcer disease greatly increases the risk of HIV acquisition. This study also showed that chlamydial infection increases the risk of HIV infection, whereas gonococcal infection has no effect on HIV infection. In a second prospective study [9], men with STDs, recent prostitute exposure, and genital ulcers were more likely to seroconvert during a 2–6 month period than were men with urethritis. Men who had sex with a prostitute in Nairobi had a 7% chance of acquiring HIV infection after a single exposure, and this risk increased fourfold if the men had genital ulcers [9]. These studies suggest that STDs that produce genital ulcerations greatly increase the vulnerability of seronegative persons.

Recent studies of homosexual men support this hypothesis. After controlling for number of sexual partners, Handsfield and coauthors [5] showed that HIV seropositivity is associated with a history of genital, anorectal, or oral herpes; a history of syphilis; or a positive serological test for herpes simplex virus (HSV) type 2 or *Treponema*

*pallidum*. The study also showed that HIV seroconversion is associated with anogenital lesions. These findings suggest that STDs are not covariates of sexual activity but are independent risk factors for HIV infection.

Two theories have been postulated to explain the interaction between STDs and HIV infection. First, conditions that increase the number of lymphocytes in the genital tract, such as STDs, may potentiate the risk of HIV transmission by increasing the pool of target cells in a seropositive or seronegative person. Second, the disruption of the genital epithelium by STDs permits penetration by HIV [10].

Some data suggest that the presence of HIV infection also may adversely affect coexisting STDs, such as syphilis and chancroid. One study showed that standard penicillin therapy fails to cure secondary syphilis in HIV-seropositive persons [11]. A similar finding was reported in HIV-seropositive persons with chancroid [10].

### CONDOMS AND STDs

In vitro studies have shown that an intact condom provides an effective barrier against HSV, HIV, cytomegalovirus, *Neisseria gonorrhoeae*, *Chlamydia trachomatis*, and mycoplasma [12–14]. Other laboratory studies have demonstrated that HIV cannot pass through plain latex condoms despite the use of virus concentrations higher than those found in semen [15]. A condom lubricated with nonoxynol-9 (N-9) may be effective against HIV even when the condom ruptures. Three studies found that intact condoms lubricated with N-9 did not leak HIV; when these condoms were deliberately ruptured, the HIV was still inactivated [15]. Several clinical studies demonstrated that condoms protect men and women against bacterial and viral infections [13,14]. The correct use of a condom provides an effective mechanical barrier: for a man, a condom reduces the risk of infection acquired through penile exposure to cervical, vaginal, vulvar, or rectal secretions or lesions; for a woman, a condom prevents exposure of the female genital mucosa to urethral discharge, semen, and lesions of the penis.

When condoms are used with other barrier methods, the condom's protective effects appear to be enhanced. In one case-control study, condoms used alone reduced the risk of gonorrhea in women by 13%. In women using both condoms and spermicides, the risk of gonorrhea was reduced by 59% [16].

A few studies have shown that condoms offer some protection against HIV. In a study of Danish prostitutes, condoms were used in 68% of episodes of vaginal intercourse, 54% of episodes of fellatio,

and 3% of anal sex episodes. None of the prostitutes was seropositive for HIV [17]. In another study of 448 German prostitutes who used condoms extensively, 97.5% with vaginal intercourse and 55% with anal intercourse, none of the 399 tested for HIV was seropositive [18]. An ongoing multicenter study of U.S. prostitutes by the Centers for Disease Control found that 11% of prostitutes who reported unprotected vaginal intercourse were seropositive for HIV. None of the prostitutes who used condoms for every episode of vaginal intercourse was seropositive [19]. However, the absence of control groups in these studies greatly reduces the validity of the findings.

### SPERMICIDES AND STDs

Several studies have shown that N-9, the active ingredient of most spermicidal products, is effective *in vitro* against a variety of STD pathogens, including *Neisseria gonorrhoeae*, *Treponema pallidum*, HSV-1 and HSV-2, chlamydia, *Candida albicans*, and *Trichomonas vaginalis* [12–22]. The mechanism of action of N-9 is based primarily on its surfactant properties; it immobilizes sperm, bacteria, and viruses by disrupting cell membranes and viral envelopes [23]. A few studies also have shown that N-9 and active ingredients in other spermicidal preparations inactivate HIV *in vitro*. In one study [24], HIV inactivation occurred within 60 sec of exposure to an N-9 concentration of 0.05% or greater; this concentration was also toxic to the lymphocytes infected by the virus. Other studies have confirmed that a concentration of 0.05% N-9 disrupts free HIV.

*In vivo* studies support the *in vitro* findings that spermicides offer protection against STDs. For women, this protection is enhanced when spermicide use is combined with another barrier method, such as a diaphragm or condom. In one case-control study [16], the use of spermicide with a diaphragm reduced the risk of gonorrhea by 55%. The use of spermicide alone reduced the risk of gonorrhea by only 10%. In a study by Family Health International (FHI) in Bangkok, the use of the N-9 contraceptive sponge reduced the women's risk of acquiring gonorrhea by 69% and of acquiring chlamydia by 33% [25].

Few studies have evaluated the effectiveness of spermicides in preventing HIV transmission. A study of the protective effects of the contraceptive vaginal sponge (Today<sup>®</sup>; containing 1  $\mu$ m of N-9) against the transmission of HIV is ongoing in Kenya, but results are not yet available [26]. In another study, FHI is evaluating the acceptability of a new female condom.

## DISCUSSION

The AIDS epidemic has drawn attention to other STDs, which, until recently, have received little notice from policy makers and health providers. Sexual transmission of HIV is the most important mode of spread of the AIDS epidemic in developing countries. STD control is an important component of AIDS prevention activities for several reasons:

- 1 AIDS is spread predominantly by sexual intercourse. Public health measures used to control other STDs are applicable in AIDS prevention.
- 2 Epidemiological evidence strongly suggests that individuals who practice high-risk sexual behavior are at risk of acquiring a range of STDs, including HIV infection. The highest rates of HIV infection usually are found in prostitutes and other persons who have multiple sexual partners and high rates of STDs.
- 3 Evidence is increasing that the presence of STDs increases the risk of HIV infection.
- 4 Prevention of STDs, whether through reducing the number of sexual partners or through use of barrier methods, will reduce HIV transmission.

The effects of condoms in preventing most STDs, including HIV, are assumed to be protective enough to justify their widespread use in AIDS intervention programs. Condoms are safe, relatively cheap, devoid of side effects, and effective when used correctly and consistently for birth control. The major drawback of condom use in family planning programs has been the relatively high failure rates. Failure of condoms to protect against pregnancy is explained by user failure more often than by product failure. The factors that influence use effectiveness are important in preventing both pregnancy and STDs, including HIV. Most research about condoms has focused on their use as a contraceptive to prevent pregnancy. Whereas the risk of pregnancy usually occurs during a narrow time span (2–3 days) during a woman's menstrual cycle, STD and HIV transmission can occur each time a couple has sex. To be effective in preventing HIV and other STDs, condoms must be used correctly with every sexual act, especially by persons for whom the risk of HIV infection is high. This caveat is important for high-risk groups, such as prostitutes, who have a large number of sexual partners and other cofactors, such as genital ulcer disease.

Some evidence shows that the correct and regular use of condoms protects against several STDs, including HIV, but further research is required. However, the protective effect of condoms against STDs and HIV may be synergistic because STDs, such as chancroid, syphilis, chlamydia, and herpes, appear to increase the risk of HIV infection. On the other hand, condoms may not protect against infections acquired from an open genital ulcer disease that is not located on the penis. The acceptability and extent of use of condoms, and other factors that affect condom failure, also should be studied. Ultimately, we may have an acceptable and effective method that protects against pregnancy and HIV and other STIs.

Spermicides appear to offer some protection for both men and women against STDs, particularly when used with other barrier methods [16,25]. The protection may be only slight when a spermicide is used alone [16]. Insufficient information is available to determine the effectiveness of spermicides in preventing HIV transmission. However, use of a spermicide with a condom or diaphragm may reduce the risk of HIV indirectly by reducing the risk of STDs. Despite the need for a female-driven barrier method to prevent HIV infection in high-risk groups such as prostitutes, promoting the use of spermicides alone does not appear to be justified by the available evidence [27,28]. FHI is supporting a study to assess the efficacy of N-9 spermicides in preventing HIV infection in Zambia, and another study is planned for the Cameroon.

## THE NEED FOR FURTHER RESEARCH

In the past few years, our knowledge of the epidemiology and prevention of AIDS has lagged behind our increasing knowledge of HIV. Studies are urgently needed to help us understand the interaction between STDs and HIV more thoroughly and to evaluate the protective effects of condoms and spermicides or virucides against STDs and HIV transmission. Answers to the following questions are needed:

- 1 Interaction between HIV and STDs:
  - a. What is the pathophysiology of the interaction between STD and HIV infection?
  - b. What is the relative risk of STDs, especially genital ulcer disease, in different subpopulations, including groups at relatively low risk of HIV infection?
  - c. Do STDs accelerate the progression from HIV infection to AIDS?

- d. Does a preexisting HIV infection adversely affect the response to treatment of an existing or newly acquired STD?
  - e. Do the treatment and control of STDs lower the risk of HIV infection in a high-risk population?
- 2 Barrier contraception and STDs/HIV:
- a. Does the regular and correct use of condoms alone prevent STDs? What level of protection is afforded for each STD? Does the regular and correct use of condoms alone prevent HIV infection?
  - b. Does the regular and correct use of spermicides alone prevent STDs? What level of protection is offered for each STD? Does the regular and correct use of spermicides prevent HIV infection?
  - c. What effect does each of these combinations of barrier contraceptives have on preventing STDs or HIV infection: condom with spermicide, diaphragm with spermicide, spermicidal sponge, female condom with spermicide?
  - d. Do spermicides other than N-9, or virucides, prevent the sexual transmission of HIV infection?

Even if we demonstrate unequivocally that barrier methods prevent STDs, including HIV, these contraceptives must be used regularly and correctly to be effective. Further research is required on ways to increase the acceptability and use of these methods to reduce failure rates.

Barrier contraceptives do not constitute the primary solution to the AIDS epidemic. Reduction or elimination of sexual activity with persons who exhibit high-risk behavior, reduction in the number of sexual partners, and mutual monogamy are the most effective preventive measures. Although barrier contraceptives may only reduce the risk of STDs and HIV infection rather than eliminate the risk entirely, they should be recommended for persons at risk.

## REFERENCES

1. Piot P, Plummer FA, Rey MA, Ngugi EN, Rouzioux C: Retrospective seroepidemiology of AIDS virus infection in Nairobi populations. *J Infect Dis* 155:1108-1112, 1987.
2. Kreiss JK, Koech F, Plummer FA, Holmes KK, Lighfoote M: AIDS virus infection in Nairobi prostitutes: Spread of the epidemic to East Africa. *N Engl J Med* 314:414-418, 1986.
3. Plummer FA, D'Costa LJ, Nsanze H, Dylewski J, Karasira P, Ronald AR: Epidemiology of chancroid and *H ducreyi* in Nairobi Kenya. *Lancet* 2:1293-1295, 1983.

4. **Plummer FA, Simonsen JN, Ngugi EN, Cameron DW, Piot P, Ndinya-Achola JO:** Incidence of human immunodeficiency virus (HIV) infection and related disease in a cohort of Nairobi prostitutes. Abstract M84: III International Conference on AIDS, Washington, DC, 1987.
5. **Handsfield HH, Ashley RL, Rompalo AM, Stamm WE, Wood FW, Corey L:** Association of anogenital ulcer disease with HIV infection in homosexual men. Abstract F16: III International Conference on AIDS, Washington, DC, 1987.
6. **Greenblatt RM, Lukehart SA, Plummer FA, et al.:** Genital ulceration as a risk factor for HIV infection. *J AIDS* 2:47-50, 1988.
7. **Kreiss J, Carol M, Meheus A:** Role of sexually transmitted diseases in transmitting HIV. *Genitourin Med* 64:1-2, 1988.
8. **Simonsen JN, Cameron DW, Gakinya MN, et al.:** Human immunodeficiency virus infection among men with sexually transmitted diseases. *N Engl J Med* 319:274-278, 1988.
9. **Cameron DW, Plummer FA, Simonsen JN, Ndinya-Achola JO, D'Costa LJ, Piot P:** Female to male heterosexual transmission of HIV infection in Nairobi. Abstract MP91: III International Conference on AIDS, Washington, DC, 1987.
10. **Piot P, Plummer FA, Mhalu FS, Lamboray JL, Chin J, Mann JM:** AIDS: An international perspective. *Science* 239:573-579, 1988.
11. **Lukehart SA, Hook EW, Baker-Zander SA, Collier AC:** Invasion of the central nervous system by *treponema pallidum*. *Ann Intern Med* 109:855-862, 1988.
12. **Feldblum PJ, Fortney JA:** Condoms, spermicides, and the transmission of HIV: A review of literature. *Am J Public Health* 78:52-54, 1988.
13. **Stone KM, Grimes DA, Magder LS:** Primary prevention of STDs. *JAMA* 255:1763-1766, 1986.
14. **Conant MA, Spicer D, Smith C:** Herpes simplex virus transmission: Condom studies. *Sex Transmitted Dis* 11:94-95, 1984.
15. **Judson FM, Bodin GF, Levin MJ, Ehret JM, Rietmeijer CA:** In vitro evaluations of condoms with and without nonoxynol-9 as physical and chemical barriers against chlamydia trachomatis, HSV type 2 and HIV. *Sex Transm Dis* 16:51-56, 1989.
16. **Austin H, Louw W, Alexander J:** A case control study of spermicides and gonorrhoea. *JAMA* 251:2822-2824, 1984.
17. **Krogsgaard K, Gluud C, Pedersen C, et al.:** Widespread use of condoms and low prevalence of STDs in Danish non-drug addict prostitutes. *Br Med J* 293:1473-1474, 1986.
18. **Smith GL, Smith KF:** Lack of HIV infection and condom use in licensed prostitutes [letter]. *Lancet* 2:1392, 1986.
19. **Centers for Disease Control:** Antibody to HIV in female prostitutes. *MMWR* 36:157-161, 1987.
20. **North B:** Vaginal contraceptives: Effective protection from STDs for women? *J Reprod Med* 33:307-311, 1988.

21. **Kappus E, Quinn T:** The spermicide nonoxynol-9 does not inhibit chlamydia trachomatis in vitro. *Sex Transmitted Dis* 13:134-137, 1986.
22. **Berger KL, Remington K:** The prophylactic properties of the Today\* sponge and other spermicides containing contraceptives. *Adv Contraception* 3:125-131, 1987.
23. **Centers for Disease Control:** VD Fact Sheet, 1975, 32 ed. Atlanta; CDC, 1976.
24. **Hicks DR, Martin LS, Getchell JP:** Inactivation of HTLV/LAV-infected cultures of normal human lymphocytes by nonoxynol-9 in vitro [letter]. *Lancet* 2:1422-1423, 1985.
25. **Rosenburg MJ, Rojanapithayakorn W, Feldblum PJ, Higgins SJ:** Effect of the contraceptive sponge on chlamydia, gonorrhea and candidiasis: A comparative clinical trial. *JAMA* 257:2308-2312, 1987.
26. **Kreiss J:** Nonoxynol-9 and Prevention of Sexual Transmission of HIV [report]. Seattle: University of Washington, 1988.
27. **Kreiss J, Cameron DW, Ngugi E, et al.:** Efficacy of the spermicide nonoxynol-9 (N-9) in preventing heterosexual transmission of HIV. Abstract 6525: IV International Conference on AIDS, Stockholm, June, 1988.
28. **World Health Organization:** Consultation on Prevention and Control of Sexually Transmitted Diseases in Population Groups at Risk. Consensus Statement, Chemical Prophylaxis. Geneva; WHO, 1988.

## DISCUSSION

DR. MARX: Can you indicate the prevalence of HIV-1 and HIV-2 cases between western Africa and central Africa?

DR. LAMPTEY: I am sorry, I do not have the data, but most of the HIV-2 cases diagnosed so far have been in western Africa. There have been isolated cases in Angola and Mozambique. Probably the countries with the highest prevalence of HIV-2 are Guinea Bissau and then Burkina Faso. Some studies showed that 30% of the cases of HIV infection were with HIV-2.

DR. MARX: So HIV-2 is in the minority?

DR. LAMPTEY: Yes.

DR. MATA: Do you have any suggestions regarding changing policies towards the use of contraceptives?

DR. LAMPTEY: The data from Africa may not be relevant to Latin America, where we are just beginning to learn things that we did not suspect. For instance, in Cali, Colombia, a recent study showed that 60% of heterosexual couples regularly have anal sex. In Costa Rica, one in every five men who come to our clinic seeking HIV testing regards himself as homosexual. The word gay is not much used in Central America. Some homosexual men, even married men, have regular sex with women. We have to urge couples to use condoms.

For people who are not very well educated, we have to promote the idea that it protects against infection too.

DR. GUINAN: I would just like to endorse what Dr. Lamprey said about looking at different subpopulations and their risk for STD and HIV transmission. In the United States, one of the things that would bear considerably on the heterosexual transmission of HIV is the crack epidemic. This epidemic, which was not mentioned except by Dr. Potts earlier, is now pervasive in the United States, and not only in the inner cities but also in smaller towns. The epidemic of STDs that Dr. Ward Cates' group has been detecting recently, including much of the increase in syphilis, is associated with crack and crack houses, where sex is exchanged for drugs. This affects women very much. In the United States, women are less likely to be IV drug users, but crack apparently affects men and women equally. There seems to be a great desire to have sex while on crack.

In this particular situation, where there is no rational behavior, talk of condoms or contraceptives is not something that is very relevant. The increasing problem that we are seeing in this country is the fact that these women, especially those who are exchanging sex for drugs, are highly susceptible to HIV. This is because the men who come to the crack houses are likely to be IV drug users, such as IV cocaine users, and are likely to be HIV-positive and to infect the women. This population must be studied.

In the United States, when we are thinking about prevention, we have to realize, as Ward Cates' group has shown, that the risk of STDs is directly related to these crack houses. That is an observation that we as public health workers have to recognize and put into our strategy for preventing the heterosexual transmission of HIV.

DR. CAIN: I agree with your statement about the data on sexual behavior being woefully inadequate throughout the world, so I was very interested in your comments about Brazil and the increase in the heterosexual spread of HIV. Could you comment on your source of data, particularly the sexual behavior data on the use of transvestite prostitutes by married men?

DR. LAMPREY: I am sorry but those data are anecdotal. A physician I talked to who has been seeing men with gonorrhea provided this information. He says that he cannot publish his data.

DR. MATA: In Brazil, a psychiatrist published a book in which he described transvestite prostitutes. In Costa Rica, about two hundred male transvestites who were basically transsexual and used a lot of hormones were studied. Some of them were indistinguishable from a beautiful lady. We have wrong ideas about these people. When we go deeply into their behavior we find that most of them will serve as

passive partners, but they have very complex practices. The men who seek them seek beautiful women, but they engage in anal intercourse. They penetrate these men. But some of the men, maybe 15%, also have relations with women. They are certainly a source of STDs, but not HIV in Costa Rica so far.

DR. CONE: We all talk about vaginal intercourse and anal intercourse as if that is the mechanism of transmission. When I talk with students, they are all surprised to discover that the problem is that semen contains the pathogens and white blood cells, and that it is the source of HIV. I think if we could come up with sort of a jingle so that people would understand this better, it would help. One jingle could be, "semen and sores." I guess men do not want to think that their semen can be the vector, but somehow we have to get across the point that it is not intercourse per se, but rather that the ejaculate contains the virus.