PAPERS AND SHORT REPORTS

Bacteriological colonisation of uterine cavity: role of tailed intrauterine contraceptive device

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Abstract

Intrauterine contraceptive devices (IUCDs) are thought to cause pelvic inflammatory disease by allowing vaginal bacteria to pass into the uterus along the tail of the device. In this study the uterine cavities of 22 women using an IUCD were examined by a multiple biopsy technique. All five uteruses with a tailless IUCD were sterile but 15 out of 17 with a tailed device contained bacteria. The bacteria had not reached the fundus and most were commensals. The bacteria were not introduced by insertion of the IUCD as bacteria were present in several cases long after insertion. No differences in bacterial count were found between monofilamentous and multifilamentous devices. Bacteria were cultured from only four devices, which suggested that the bacteria adhere to the endometrium and not to the device.

The bacteria in the cavity represent interference by the tail with the protective mechanisms of the uterus, which explains the increase in pelvic inflammatory disease in IUCD users.

Introduction

Intrauterine contraceptive devices (IUCDs) and the earlier cervicouterine devices have been blamed as causes of pelvic inflammatory disease.[1] The projection of part of the device through the cervical canal is thought to allow easy access of vaginal bacteria to the upper genital tract. Indeed, 50 years ago Grafenberg[2,3] specifically removed the cervical tail from his devices to eliminate this aspect. The modern nylon tail was independently reintroduced by Lippes[4] and by Zipper and Sanhueza.[5] Elstein[6] showed that the cervical appendage played a part in the pathogenesis of pelvic inflammatory disease in IUCD users. Tatum *et al*[7] suggested that a multifilamentous type of IUCD tail facilitated the ascent of organisms into the uterus more than other tails. Weström *et al*[8] showed laparoscopically an increased incidence of pelvic inflammatory disease in IUCD users. They found that the greatest risk was to the nulligravida, a finding confirmed by Eschenbach *et al*[9] but disputed by Osser *et al.*[10] Certainly in the nulliparous IUCD user there was an increased risk of pelvic inflammatory disease in the younger age groups.[11]

We examined the effect of various types of tailed and tailless IUCDs on the bacteriological status of the uterus. The findings from control uteruses without an IUCD have been reported.[12]

Methods

Twenty-two women who were undergoing hysterectomy and who had a variety of IUCDs in situ were studied. Fourteen women were using a device with a monofilamentous tail; of these four were using a Lippes loop, two a Saf-T-Coil, seven a Gravigard, and one a Dalkon shield. The remaining eight women were using Dalkon shields, three with multifilamentous tails and five with no tails. Their ages ranged from 27 to 42 years (mean 35 years). The duration of IUCD use ranged from 7½ months to nine years (mean 6½ years) in the Lippes loop and Saf-T-Coil users; from seven months to 3½ years (mean two years) in the Gravigard users; from two months to several years (usually less than six months) in those using tailed Dalkon shields; and from eight days to eight months (mean three months) in those with Dalkon shields without tails. The main indication for hysterectomy was menorrhagia often coupled with a request for sterilisation. Twenty-one hysterectomies were abdominal and one vaginal (with a tailless Dalkon shield). No routine preoperative vaginal antisepsis was used. Immediately before operation the cervix was exposed with an unlubricated sterile Cusco speculum. Samples were taken from the vaginal vault and from the ectocervix with charcoal-coated swabs that were placed in Stuart transport medium.

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After hysterectomy the anterior uterine wall was incised downwards from the fundus to the external os. During this procedure full aseptic techniques were used and care was taken not to contaminate the cavity with any cervical organisms. The IUCD was removed and cut into sections including samples from the parts of the tail in the uterine cavity, cervical canal, and vagina. The sections were placed in 2 ml of tryptone-arginine-serine broth (TAS broth). A series of samples with surface areas of about 30 mm^2 was demarcated along the posterior wall of the uterine cavity and cervical canal using specifically designed stainless steel borers 6 mm in diameter. The mucosa was separated from the underlying tissue and placed in 9 ml of TAS broth. The samples were immediately transported to the laboratory. Each tissue sample in TAS broth was poured into a sterilised plastic bag and an anaerobic gas mixture was flushed through for 10 seconds to ensure the viability of any anaerobic organisms. The samples were homogenised and aliquots of 500 μl, 100 μl, and 10 μl as well as the vaginal and ectocervical swabs were plated on a variety of media and incubated for 48 or 96 hours (table I).

TABLE I—*Bacteriological techniques*

Medium	Culture conditions	Incubation period at 37°C (hours)
Blood agar	Aerobic	48
McConkey agar	Aerobic	48
Chocolate agar	Aerobic with added carbon dioxide	48
Anaerobic selective agar*	90% hydrogen and 10% carbon dioxide	48 and 96

*Containing colistin, neomycin, menadione, and haematin.

The IUCD and tail sections in TAS broth were vortex mixed to ensure even distribution of any bacteria and aliquots of 100 μl and 10 μl were inoculated on to the same media. The organisms cultured were identified by standard laboratory techniques and bacterial counts calculated per unit surface area of the tissue samples and IUCD tails. The results were analysed by the Fisher exact probability test.

Results

The total mean length of the uterine cavities and cervical canals was 75 mm and the mean length of the cervical canals alone was 35 mm.

The number of tissue biopsy specimens from each cavity and canal ranged from seven to 10 (mean and median nine). The predominant organisms isolated from the vaginal vault, ectocervix, and cervical canal were *Lactobacillus* sp, *Bacteroides* sp, and *Staphylococcus epidermidis* with several other species, some of which were potentially pathogenic (table II).

The number of tissue biopsy specimens from the uterine cavities only, excluding the cervical canals, ranged from four to seven (mean and median five). Bacteria were found in the uterine cavities of 12 of the 14 uteruses with a monofilamentous-tailed IUCD and in all three cavities containing a multifilamentous-tailed Dalkon shield. One cavity with a Lippes loop (eight years in situ) and one with a Gravigard (3½ years in situ) were sterile, although organisms were present in the upper part of the cervical canal in both. Two patients with bacteria in the cavity and one with a sterile cavity (all with monofilamentous-tailed devices) had received antibiotics for non-gynaecological reasons in the two months before operation. The commonest organism found in the cavity was *Lactobacillus* sp (8); other bacteria found were: *Gardnerella vaginalis* (3), anaerobic streptococci (2), *Bacteroides fragilis* (1), *Streptococcus faecalis* (1), *Staphylococcus epidermis* (1), and *Escherichia coli* (1). The surface bacterial counts showed a diminishing bacterial gradient as the cervical canal was ascended, with few bacteria in the uterine cavity, and no differences between monofilamentous and multifilamentous tails (table III). The bacteria did not reach the level of the fundus in 13 of the 15 uteruses with bacteria in the cavity (87%). The mean distance reached by the bacteria was 20 mm from the fundus (range 2-31 mm).

TABLE II—*Organisms isolated from the cervical canal, ectocervix, and vaginal vault in 22 IUCD users*

Organism	Number of isolations		
	Cervical canal	Ectocervix	Vaginal vault
Lactobacillus sp	10	12	13
Staphylococcus epidermidis	1	4	7
Bacteroides sp	5	10	9
Potentially pathogenic aerobes*	7	9	9
Commensal aerobes†	7	8	8
Other anaerobes‡	4	4	3

* Group A β-haemolytic streptococci, *Escherichia coli*, *Streptococcus faecalis*.
† *Gardnerella vaginalis*, *Corynebacterium* sp, yeasts.
‡ Anaerobic corynebacteria, anaerobic streptococci.

TABLE III—*Surface bacterial counts and levels of bacterial isolation in 17 uteruses with a tailed IUCD (multifilamentous tails included in totals and noted separately in parentheses)*

Bacterial count/mm^2	No of isolations								
	Ectocervix	Cervical canal and uterine cavity: levels of isolation (mm from external os)							
		0-10	11-20	21-30	31-40	41-50	51-60	61-70*	71-80†
No growth	2 (1)	2			3	5	7 (1)	11 (3)	8 (1)
1- 25	3	2	5	11 (1)	10 (2)	8 (2)	9 (2)	5	1
26- 50	3		4	2 (2)		2			
51- 100	1	5	3 (2)	1	3 (1)	1	1		
101- 250	1	1 (1)	1	3	1				
251-1000	2 (1)	2 (1)	2			1 (1)			
1001-2500	1	1							
>2500	4 (1)	4 (1)	2 (1)						

* Fundus already reached in one uterus.
† Fundus already reached in eight uteruses.

All five cavities containing a tailless Dalkon shield were sterile, as were three of the cervical canals. The two remaining canals contained bacteria in their lower parts only. The devices were sterile.

Although 15 of the 17 cavities with a tailed IUCD contained bacteria, organisms were cultured from only four of the devices (27%) and the associated endometrial portions of the tail (Gravigard 2; Lippes loop 1; multifilamentous Dalkon shield 1). In addition one Saf-T-Coil had bacteria isolated from the endometrial portion of the tail but not from the device. Bacteria were isolated from all but one of the vaginal portions of the tails but from only six (40%) of the cervical portions. The bacterial counts on the surface of the cervical portions were considerably less than those on the vaginal ones.

The proportion of women with bacteria in the uterine cavity was significantly greater in those using a monofilamentous IUCD than in those using a tailless Dalkon shield and in a control group without IUCDs (Fisher exact test: $p = 0.002$ and $p < 0.001$ respectively).

Discussion

Using the same techniques, we have previously shown[12] in a study of 50 control uteruses without IUCDs that the normal uterine cavity is always sterile but that the lower half of the cervical canal sometimes contains bacteria. These bacteria show a diminishing gradient of bacterial counts as the canal is ascended, implying a bactericidal role for the cervical mucosal surface and its mucus coat.

In previous studies the IUCDs have usually been cultured after removal[13] or by inserting swabs or aspiration instruments through the cervical canal.[14-16] These have produced results wrongly suggesting that most uteruses, with or without an IUCD, contain bacteria. Unfortunately the vagina and ectocervix cannot be adequately sterilised and all studies using the transcervical route have been subject to bacterial contamination at the external os. Many results are explicable only on the basis that the organisms have come from the lower genital tract.[17]

Contamination is avoided by hysterectomy studies. Mishell *et al*[17] cultured endometrium obtained by curettage through the opened anterior uterine wall of Lippes loop users after vaginal hysterectomy. Bacteria were found in all the uterine cavities within 24 hours of IUCD insertion, with fewer uteruses containing bacteria up to 30 days after insertion, after which the uteruses were always sterile. They concluded that IUCD insertion introduced bacteria that disappeared within a few weeks.

Our results show the presence of bacteria from the vaginal flora in the uterine cavity of those using tailed IUCDs irrespective of the interval since insertion. The actual numbers were very small as determined by bacterial counts. By using a multiple biopsy technique together with improved anaerobic culture techniques we were able to find and identify the sparse bacterial flora. In contrast Mishell *et al*[17] could identify only the gross bacterial contamination induced at IUCD insertion. In a previous study[18] the uterine cavity was opened during vaginal sterilisation and bacteria were found long after insertion in 68% of Lippes loop users.

The uterine cavities of those using the tailless IUCD were sterile and gave the same picture as the cavities of those without an IUCD[12]—that is, the cervical canal remained sterile or had bacteria only in the lower part. Although the uterine cavities of all but two of the users of tailed IUCDs contained small numbers of bacteria, these did not usually reach the fundus, irrespective of the nature of the tail. Clearly the tail was implicated but no differences in counts were seen between monofilamentous- and multifilamentous-tailed devices. This suggested that the supposed passage of bacteria by capillary action inside the outer sheath of multifilamentous tails[7] did not appreciably contribute to the ascent of bacteria into the uterine cavity. Even in the two uteruses without bacteria in the cavity the ability of the tail to facilitate the ascent of organisms was shown by the finding of bacteria in the upper part of the cervical canal.

Bacteria were cultured from only 27% of the IUCDs in cavities containing bacteria, indicating that bacteria adhere mainly to the endometrium and not to the device. Most of the endometrial bacteria were commensals although some potential pathogens were present. The absence of clinical pelvic infection suggests that the bacterial colonisation is usually harmless because of the small numbers of bacteria, their failure to reach the fundus, and local defence mechanisms. The bacteria found do not represent the survival of organisms introduced at insertion as they are absent from the uteruses with a tailless IUCD. Instead they arise by the continuous ascent of vaginal bacteria up the cervical and endometrial lining in relation to the IUCD tail. The presence of pathogenic organisms in increased numbers or with some impairment of the protective processes, local or systemic, would lead to an increase in bacterial counts with extension of the bacteria into the deeper recesses of the uterine cavity. This process is recognised clinically as the progressive endometritis syndrome with offensive vaginal discharge and menstrual upset.[13] Extension of bacteria to the tubes explains the tendency to an increase in pelvic inflammatory disease noted in IUCD users.[8]

The protective mechanisms in the cervix and its mucus that prevent bacterial invasion of the uterus include downward ciliary action and a local secretory immune system producing secretory IgA.[19] The micelle arrangement of the mucin allows sperm penetration mid-cycle but not at other times[20]; similar restraints may apply to bacteria. The ability of several species of pathogenic bacteria to migrate through mid-cycle mucus adhering to IUCD tails has been shown in vitro.[21] Possible interference with cervical mucin structure by the cervical appendage is suggested by the increased sperm penetration of luteal phase mucus in Lippes loop users.[22] A protective role for the endometrium is likely although no inhibition of common pathogens other than *Neisseria* sp has been shown.[23]

The continued presence of bacteria in the uterine cavities of women using tailed IUCDs again raises the question of whether tails should be removed from devices, as originally suggested by Grafenberg.[2 3] The 50-year controversy between tailed and tailless devices has recently been reviewed.[24] The findings in our study support the notion that tailed IUCDs predispose to the ascent of organisms. Indeed, in nulliparous women, who probably have a greater risk of acquiring pelvic inflammatory disease, careful consideration should be given to whether an IUCD should be used at all. If it is inserted thought should be given to removing the cervical appendage or cutting it short within the cervical canal. Certainly research is required urgently to achieve a better understanding of the protective mechanisms of the uterus. The tail of the IUCD has been shown to interfere with these mechanisms since its role in facilitating the ascent of organisms has been clearly shown in this study.

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