PRIMATOLOGY

Study of the Prevalence of Agents of Sexually Transmitted Diseases in Monkeys by the Gene Diagnosis Method

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Carriership of agents of sexually transmitted diseases (Trichomonas, Chlamydia, Mycoplasma, Ureaplasma) is highly prevalent in healthy monkeys living in the Adler Breeding Center. The incidence of these microorganisms is appreciably higher in animals with gestoses and labor abnormalities in comparison with animals with normal genital function. Mixed infection caused by 2-4 agents is much more incident than monoinfection.

Key Words: *sexually transmitted disease agents; gene diagnosis*

Infections of the urogenital tract are a serious medical and social problem. Sexually transmitted diseases (STD) are responsible for an appreciable percentage in the structure of all human infections. Medical records indicate that abnormalities of pregnancy and labor, early spontaneous abortions and stillbirths are due to, among other causes, infections caused by Chlamydia, Mycoplasma, Ureaplasma, and Trichomonas, which now attract special attension [1,2]. High prevalence of these microorganisms and their frequent detection in normal subjects impede evaluation of their role in the etiology and pathogenesis of STD. The development of models of these diseases on primates as animals most close to humans by the spectrum of infections and their agents, is a pressing problem. Reports about reproduction of chlamydial and mycoplasma urogenital infections in monkeys are scanty [6,7]. We failed to find any reports about the etiological relationship between genital abnormalities in monkeys (often observed during their breeding) and spontaneous infections of healthy animals by Chlamydia, Mycoplasma, Ureaplasma, and Trichomonas.

We studied natural infection by STD agents in monkeys of different species with and without pregnancy and labor abnormalities.

MATERIALS AND METHODS

The study was carried out in Macaca iris (n=62), M. rhesus (n=68), M. nemestrina (n=24), and Papio hamadryas (n=54), in normal males and females and in females with pregnancy and labor abnormalities. A total of 208 animals aged 1-26 years were examined.

The majority of monkeys were born at Adler Institute of Medical Primatology. The monkeys were kept in open cages (200-1000 m^2) or in group cages, 5-7 animals per cage. The animals received granulated fodder balanced for all ingredients.

Scrapings of vaginal epithelial cells collected from healthy females and females with abnormalities, scra-

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pings from male urethra, and from the cervical canal and uterus of dead females were examined.

The material was collected using universal disposable probes. *Trichomonas vaginalis*, *Mycoplasma hominis*, *Chlamydia trachomatis*, *Ureaplasma urealyticum* were identified by the gene diagnostic method [4]. PCR was prepared and carried out using commercial kits manufactured by LITKh Firm and Institute of Epidemiology, which guarantee high (95%) diagnostic efficiency, particularly in persistent infections.

RESULTS

Four agents of the studied infections were detected in vaginal and urethral scrapings from 66 of 142 (46.6%) healthy monkeys. The infection rate of healthy M. iris and M. nemestrina was particularly high. The agents of STD were detected in 22 of 32 M. iris and in 11 of 16 M. nemestrina (69.7% cases). Despite high incidence of these agents, no clinical signs of infection were detected in these animals, which coincides with similar observations in humans [1].

Chlamydia and mycoplasma were the most incident (23.9 and 19.0%, respectively), Ureaplasma and Trichomonas were less incident (10.6 and 9.8%, respectively). Analysis of the incidence of pathogens in different monkey species showed that M. iris and M. nemestrina were infected most often (Table 1).

The group of clinically healthy monkeys included 115 adult females aged 4-23 years, 27 of these were infertile. The incidence of STD infection in sterile females was significantly higher than in healthy adult females with normal fertility (Fig. 1). The incidence of Trichomonas and Ureaplasma was 4 and 2.5 times higher and that of Mycoplasma and Chlamydia 1.5 and 2 times higher in infertile females in comparison with fertile ones.

The persistence of STD agents in healthy males was often observed. The agents of STD (mainly monoinfection, in just few cases mixed infection) were detected in 6 of 11 males.

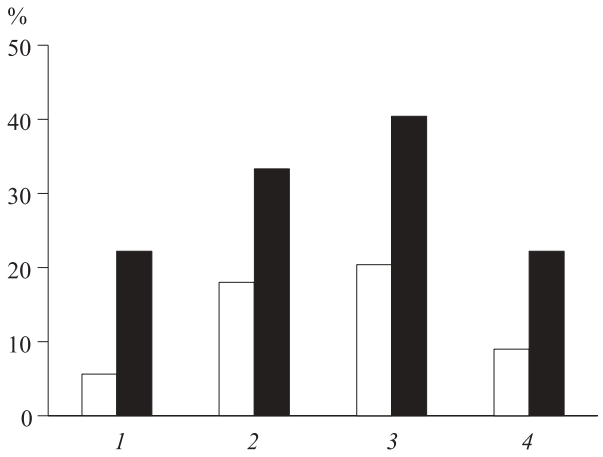

Fig. 1. Incidence of agents of sexually transmitted diseases in normal (light bars) and infertile (dark bars) females. *1*) *T. vaginalis*; *2*) *M. hominis*; *3*) *C. trachomatis*; *4*) *U. urealyticum*.

Analysis of the prevalence of STD agents in monkeys of different age showed that STD agents were not detected in monkeys aged under 1 year, while the infection rate in young (2-3 years) animals was just slightly lower than in adult monkeys (4-20 years and more): 40.0 and 45.9%, respectively.

Healthy animals were infected mainly by one of STD agents, more often Chlamydia (23.9%) or mycoplasma (19%), though mixed infection (2 agents, rarely 3-4) was also observed.

The incidence of STD agents in the urogenital tract of monkeys with pregnancy and labor abnormalities (spontaneous abortions, stillbirths, postpartum and postabortion complications, pathological labor) was drastically higher (95.4%). In only 3 of 66 animals examined no STD agents were found (2 M. iris and 1 M. rhesus with spontaneous abortions).

The incidence of *M. hominis* and *C. trachomatis* infection was 3-4-fold higher in monkeys with abnormalities in comparison with healthy animals, the incidence of *U. urealyticum* and *T. vaginalis* was 5-6-fold higher (Table 2).

The rate of detection of nucleotide sequences of STD agents depended on the type of abnormality (Table 3).

TABLE 1. Incidence of STD Agents in Healthy Monkeys of Different Species

Monkey species	*T. vaginalis*		*M. hominis*		*C. trachomatis*		*U. urealyticum*	
	abs.	%	abs.	%	abs.	%	abs.	%
M. iris (*n*=32)	4	12.5	14	43.7	11	34.3	4	12.5
M. rhesus (*n*=53)	4	7.3	8	15	9	16.9	7	12.5
M. nemestrina (*n*=16)	3	18.7	5	31.1	7	43.7	1	6.2
P. hamadryas (*n*=41)	3	7.3	0	0	7	17.0	3	7.3
Total (*n*=142)	14	9.8	27	19.0	34	23.9	15	10.6

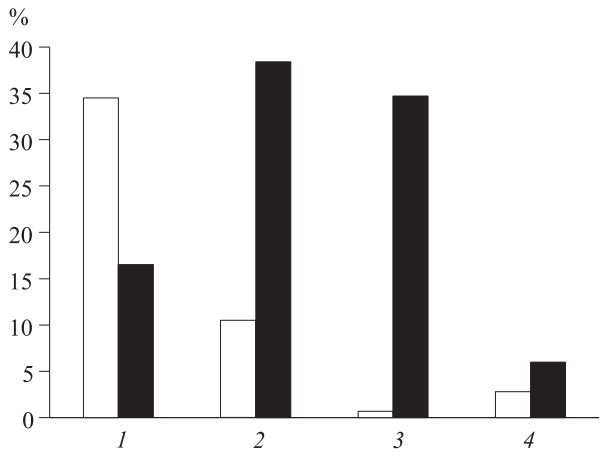

Fig. 2. Mono- and mixed infection in normal monkeys (light bars) and monkeys with abnormalities (dark bars). *1*) monoinfection; *2*) mixed infection (2 agents); *3*) 3 agents; *4*) 4 agents.

The maximum number of pathogens (50-80%) was detected in animals with pathological labor. The majority of these monkeys (7 of 10) died and were examined postmortem. *M. hominis* and *C. trachomatis* were the most incident in the material from monkeys after spontaneous abortions, though the incidence of *T. vaginalis* and *U. urealyticum* was also high. The incidence of infection in monkeys with stillbirths was also high; *C. trachomatis* and *U. urealyticum* were detected in this group. The majority of monkeys in this group had repeated (6-10) stillbirths. In contrast to healthy females, the overwhelming majority of monkeys with abnormal pregnancy and labor had mixed infection (2-4 pathogens). In healthy monkeys monoinfection 2.4 times predominated over mixed infection, while in animals with abnormalities mixed infection (2-4 agents) was 4.4 times more incident than monoinfection (Fig. 2).

These data indicate that natural carriership of STD agents (Trichomonas, Mycoplasma, Chlamydia, Ureaplasma) is highly prevalent among monkeys living in the Adler Breeding Center. Gene diagnosis detected nucleotide sequences of microorganisms associated with STD in vaginal and urethral scrapings collected from healthy monkeys. Healthy monkeys were infected mainly with one pathogen, though simultaneous persistence of 2-3 and more agents was also observed. The incidence of STD agents in infertile females was significantly higher than in fertile ones. Chlamydia and Mycoplasma were detected most often (40.7 and 33.3%, respectively) as mono- and mixed infection in infertile females. These data suggest that the persistence of STD agents, primarily Chlamydia and Mycoplasma, often in combination with Ureaplasma or Trichomonas in an important cause of monkey sterility.

Monkeys are infected by the age of 2-3 years, with the onset of sexual activity.

The persistence of STD agents in the urogenital tract sharply increased in animals with pregnancy and labor abnormalities. The incidence of all the studied agents was 1.5-4 times higher in comparison with nor-

TABLE 2. Incidence of STD Agents in Monkeys of Different Species with Abnormalities

Monkey species	*T. vaginalis*		*M. hominis*		*C. trachomatis*		*U. urealyticum*	
	abs.	%	abs.	%	abs.	%	abs.	%
M. iris (*n*=30)	10	33.3	18	60.0	23	76.6	13	43.3
M. rhesus (*n*=15)	10	66.6	8	53.0	10	66.6	7	46.6
M. nemestrina (*n*=8)	3	37.5	5	62.5	6	75.0	4	50.0
P. hamadryas (*n*=13)	7	53.8	9	69.2	6	46.1	5	38.4
Total (*n*=66)	30	45.4	40	60.6	45	68.1	28	42.4

TABLE 3. Incidence of STD Agents in Monkeys with Abnormalities

Abnormality	*T. vaginalis*		*M. hominis*		*C. trachomatis*		*U. urealyticum*	
	abs.	%	abs.	%	abs.	%	abs.	%
Spontaneous abortions (*n*=26)	12	46.1	16	61.5	16	61.5	9	34.6
Stillbirths (*n*=15)	5	33.3	7	46.6	10	66.6	8	53.3
Abnormal labor (*n*=10)	6	60	8	80	7	70	5	50
Postpartum and postabortion inflammatory complications (*n*=15)	6	40	8	53.3	10	66.6	7	46.6
Total (*n*=66)	29	43.9	39	59.0	43	65.1	29	43.9

mal fertile animals, mixed infection with 2-3 agents markedly predominating over monoinfection. The outcome of pregnancy and labor depends on many factors, including emotional stress, but we cannot rule out the activation of pathogenic potential of persistent infections, specifically, Chlamydia and Mycoplasma, particularly in combination with other agents, in the presence of decreased immune status.

The highest incidence of STD infection was observed in M. iris. Stillbirths and spontaneous abortions were highly incident in these monkey, as well as the persistence of all studied STD agents, primarily Chlamydia and Mycoplasma.

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