Prevalence and accompanying signs of pneumovagina and urovagina in dairy cows in the Southern Marmara region

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Original Article

Objective: Studies on the prevalence of pneumo- and urovagina in cows are rare. The aim of this study was to determine the prevalence and the most common accompanying clinical signs of pneumo- and urovagina in dairy cows. Material and methods: Between 2007 and 2010 a total of 1167 Holstein and Brown Swiss cows were examined clinically and bacteriologically. Pneumovagina was diagnosed if air was sucked in or expelled from the vagina spontaneously at any time. Urovagina was defined as the accumulation of urine at the fornix of the vagina. Results: The prevalence of pneumovagina and urovagina were 19.2% (n = 224) and 3.1% (n = 36), respectively. Several clinical findings were accompanying pneumovagina in affected cows. 77.7% of cows having pneumovagina additionally displayed foamy vaginal discharge during estrous. Passive urinary flow out of the vulva could be observed due to pressure during rectal examination in some cows with urovagina. Bacteriological examination of uterine swaps from 111 cows with pneumovagina yielded a positive result in 95.5% of the cases. Uterine samples from 20 control animals were bacteriologically positive in 45% of the cases. Conclusions and clinical relevance: Pneumovagina in cows has a much higher prevalence than published before and causes uterine infection, endometritis and infertility due to fecal contamination. Urovagina is always an accompanying sign in severe cases of pneumovagina. Foamy vaginal discharge during estrous can be regarded as pathognomonic and early sign of pneumovagina also in very mild cases. Evacuation of the uterus after parturition and a decrease in body condition score due to negative energy balance causes an increased negative intraabdominal pressure. These conditions seem to trigger the development of pneumo- and urovagina. For this reason repeat-breeders and especially cows with foamy vaginal discharge during estrous, passive urinary leakage and an angulated vulva dorsal to the ischiadic arch should be carefully examined for pneumovagina.

Key words
Cow, endometritis, air-sucking, pneumovagina, urovagina

Summary

Prevalence of pneumovagina and urovagina in dairy cows

Zusammenfassung


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Prävalenz und begleitende Anzeichen einer Pneumovagina und Urovagina bei Milchkühen der südlichen Marmara-Region
Tierärzt Prax 2012; 40 (G): 359–366
Received: May 27, 2012
Accepted after revision: August 9, 2012
Introduction

Infertility is one of the major causes of economical losses in dairy production in Turkey as well as in other countries. Infection of the tubular reproductive organs is the most important cause of reduced fertility in cows (13, 15, 26). Vaginitis, cervicitis and uterine disorders may cause early embryonic death, abortus, premature and/or still births and reduced viability, retarded growth and deaths of the newborns (2, 21, 24). In the literature rectovaginal lacerations in cows and subsequent fistulation and other related problems have been attached importance, however, perineal conformation deformities and postpartal non-traumatic pneumovagina and its relation to metritis have not been focussed on (12). Pneumovagina in horses is a well known and common situation of air sucking into the vagina (4, 18). The air is evacuated again actively by straining due to the irritation caused by the air or passively by movements of the animal. This condition is repeated continuously. Urovagina is characterized by an accumulation of urine in the vaginal fornix due to vesico-vaginal reflux. Although there are some investigations (10, 14, 22) on urovagina in dairy cows, to the best knowledge of the authors there are no studies on the prevalence and the effect of pneumovagina in dairy cows. The authors frequently encountered cases with pneumovagina and urovagina during field studies in dairy farms. Although not clearly understood there was a tendency that pneumovagina occurred after parturition, urovagina cases were observed more frequently than previously and those animals demonstrated a delayed conception. Thus, the aim of this study was to determine the prevalence and the most common accompanying clinical signs of pneumovagina and urovagina in dairy cows in the Southern Marmara region in Turkey.

Materials and methods

Examination of the dairy cows

For this study a total of 1167 dairy cows (714 Holstein Friesian and 453 Swiss Brown, age 2–10 years) were examined between October 2007 and February 2010 for signs of pneumovagina and/or urovagina. Pneumovagina was diagnosed if air could be detected in the vagina at any time or if spontaneous air inflow or outflow could be observed/heard. Urovagina was diagnosed if urine accumulation at the fornix of the vagina could be identified during vaginoscopic examination. In cows with pneumovagina and/or urovagina body condition score (BCS), structural changes of the vulva, vagina, anus and surrounding tissues as well as additional local inflammatory findings of the genital organs were recorded.

Normal cows without any evidence of pneumovagina and/or urovagina were selected randomly as controls (n = 41 for clinical parameters/measurements, n = 20 for bacteriology) and the same investigations were performed as on affected cows.

Body Condition Score

Each animal in the pneumovagina and/or urovagina group and control group was assigned a BCS between 1 and 5 (7, 9) and its relation to pneumovagina and/or urovagina was investigated. Scoring was done from 2 months post partum on.

Examination of the genital organs

Evaluation of the vulva and perineum: Length of the vulvar cleft and perineum, length and angle of the vulvar portion dorsal to the ischiadic arch/pelvic bottom and angle/obliquity of the vulva were measured with a compass and protractor, closure function of the vulvar lips was controlled in both groups (Fig. 1A and 1B). The character of the vaginal discharge was classified as normal, turbid, flocculant, mixed with urine or feces, bloody or foamy.

Rectal examination: In order to detect air in the vagina of cows with pneumovagina without obvious spontaneous air sucking, or urine in the vagina of cows with urovagina manual pressure was applied dorsally from the rectum to the vagina from cranial to caudal. During this manipulation the animal was watched if there was noisy air outflow by vibration of the vulvar labiae and/or urinary leakage from the vulva. By rectal examination signs of endometritis such as thickening of the cervix, positional alterations of the uterus, symmetry of the uterine horns, mural thickening, luminal content (presence of fluctuation and fluid), alterations of the oviducts, sizes and functional bodies of the ovaries were determined.

Ultrasonographical examination: Ultrasonography was used to detect air and/or urine accumulation in the vagina as well as fluid or pus in the uterus. Endometritis or metritis was diagnosed in cows with pathological fluid in the uterus. Diameters of the cervix and uterus were recorded. Changes of the echogenicity such as reduced echogenicity due to uterine edema or increased endometrial echogenicity were evaluated. A diameter larger than 5 cm of the cervix or of at least one uterine horn or a difference in diameter of more than 1.5 cm between both uterine horns was interpreted as suspicious for cervicitis and/or endometritis.

Examination of the vagina: Signs for vaginitis, cervicitis, cervical gap and discharge, vaginal and cervical lesions, adhesions, urovagina, pneumovagina, position and appearance of the external urethral orifice were examined by a cylindrical plexiglas and/or Polanski speculum. The portio vaginalis cervix was checked for any pathological changes with a video endoscope if necessary.

Microbiological sampling: Sterile uterine catheters were used to collect swabs from 111 cows with pneumovagina and/or urovagina and 20 control animals and transferred to sterile transport media. Bacterial isolation and identification was done in a routine manner.

Statistical analysis

In data analyses, continuous structured variables were compared between two groups (cows with pneumovagina and/or urovagina and...
normal control cows) by Mann-Whitney U test and categoric variables were analyzed by Pearson Chi-Square and Fisher’s Exact Test. P values < 0.05 were considered significant. Statistical analysis was performed using SPSS 13.0 software (SPSS Inc., Chicago, IL, USA).

**Results**

In the present study the investigation of 1167 cows revealed pneumovagina in 224 cows (19.2%) and urovagina in 36 cows (3.1%). Air suction into the vagina mostly happened in case of insufficient closure of vulvar lips and hymenal sphincter, when the abdominal muscles of the animal were relaxed or spontaneously during movement of the animal. Outflow of the air occurred spontaneously in a noisy way depending on the activity of the animal, during straining or if pressure was applied on the air distended vagina from the rectum. Different typical noises could be distinguished depending on air flowing in (fizzle) or out (bubble). A remarkable finding was that especially in severe cases of pneumovagina also urovagina was observed. In other words, all cows with an urovagina also showed signs of pneumovagina.

Comparison of groups with respect to BCS revealed a mean of 3.11 ± 0.73, 2.80 ± 0.69 and 3.04 ± 0.33 in cows with pneumovagina, cows with urovagina and control animals, respectively. There was no statistically significant difference between cows with pneumovagina and control animals, however, when cows with urovagina were evaluated separately their BCS was significantly different from controls (p < 0.001).

Cows with pneumovagina showed a variety of accompanying signs. Perineal lengths of cows with pneumovagina and/or urovagina were greater than 4 cm in 139 animals (62%), 4 cm and shorter in 85 animals (38%). Comparison with normal cows did not reveal a statistically significant difference (p > 0.05).

Vulvar length in cows with pneumovagina and/or urovagina was determined as 5.8–13.5 cm (mean 9.70 ± 1.59). Control cows had a vulvar length of 6.9–9.8 cm (mean 8.01 ± 0.71 cm). The difference of vulvar length between groups was found to be statistically significant (p < 0.001). Mean length of the vulvar portion dorsal to the ischiadic arch/pelvic bottom was measured as 1.81 ± 2.14 cm in cows with pneumovagina and/or urovagina and 1.12 ± 1.90 cm in control cows. This difference was not statistically significant (p > 0.05).
Vulvar angle of affected and control cows were measured and grouped as ≥ 20°, ≥ 30° and ≥ 40° in comparison. 193 (86.2%), 151 (67.4%) and 87 (38.8%) cows with pneumovagina and/or urovagina had vulvar angles of ≥ 20°, ≥ 30° and ≥ 40°, respectively. These differences between groups at all thresholds were statistically significant (p < 0.001). In 40.2% of cows with pneumovagina (n = 90) and in 7.3% of normal cows an additional cranial angulation of the vulva at the level of the ischiadic arch/pelvic bottom was discernable (p < 0.001). The difference between cows with pneumovagina and/or urovagina and control animals was statistically significant (p < 0.001).

Another conspicuous clinical finding was a persistent vulvar aperture characterized by a continuously open vulvar cleft and visibility of the vestibular mucosa. In 7.6% (n = 17) of cows with pneumovagina and/or urovagina vulvar lips showed insufficient closure (Fig. 2). Persistent vulvar aperture was only observed in one control animal. The difference was not statistically significant (p > 0.05).

Vaginoscopic examination of severe cases revealed continuous presence of air in the vagina and in 5.4% of these cases (n = 12) evidence of fecal material was detected in the vestibule and vagina (Fig. 3).

Cranial sinking of the anus and angulation of the vulva following stretching by the anus, perineal atrophy due to perianal fat and connective tissue atrophy (Fig. 2) was observed in 29 cows with pneumovagina and/or urovagina. None of the control animals showed this sign. Animals with this finding were clinically severely affected with pneumovagina (p < 0.05).

The most striking clinical sign in cows with pneumovagina during estrous was a foamy discharge (n = 174, 77.7%) especially in mild and moderate cases. This type of discharge contained different sizes of air bubbles ranging from soap foam appearance to little balloons (Fig. 4). Foamy discharge was also classified as turbid (n = 113) and clear (n = 61).

In 36 cows urovagina was diagnosed by urine accumulation at the fornix of the vagina (Fig. 5). In 25 out of these cases passive urine flow from the vulva was observed or urine drained spontaneously mixed with mucous fluid caused by increased pressure during rectal examination. In none of the normal cows (n = 41) passive urine flow occurred (p < 0.001).

Uterine samples from 111 cows with pneumovagina and/or urovagina were bacteriologically positive in 106 cases (95.5%). From these endometrial swabs 37.9% Escherichia coli, 15.5% Streptococcus bovis II group D, 12.9% Streptococcus bovis I group D, 7.3% Streptococcus equinus and 26.4% of 20 different bacteria could be isolated. In nine cases (45.0%) bacteria were isolated from control animals (n = 20). Identification revealed 16.3% Escherichia coli, 11.6% Streptococcus bovis II group D, 9.3% Streptococcus bovis I group D, 4.7% Streptococcus equinus and 58.1% 18 different bacteria. Comparison of cows with pneumovagina and/or urovagina to normal cows revealed a statistically significant difference concerning isolation of bacteria (p < 0.001) (Table 1).

Discussion

In the present study evaluation of routine clinical examinations of 1167 dairy cows revealed pneumovagina in 224 cases which corresponds to a prevalence of 19.2%. Yeong et al. (25) investigated only cows with reproductive problems. They diagnosed external genital organ disorders in 3.9% of cows with reproductive problems and 22.6% out of these had pneumovagina. This corresponds to a prevalence of 0.8%. Farhoodi et al. (8) encountered with 5.7% a much higher ratio, however, these investigators evaluated mostly cows with post partum lacerations and pneumovagina related to air suction due to vaginals tears. In the present study all cows of the...
dairy farms were examined and a very high prevalence of pneumovagina was found compared to the other two studies. It is not clear if this difference is due to the population examined or due to a more thorough examination and careful observation for pneumovagina and has to be supported by further studies. However, according to our surveillance pneumovagina in cows has not been paid appropriate attention until now and mild cases obviously have been overlooked.

In the above mentioned study Yeong et al. (25) diagnosed urovagina in 67.4% of cows with vulvar disorders. Vandeplassche et al. (23) observed urovagina in 35% of infertile cows whilst Farhoodi et al. (8) found a prevalence of only 1.5%. According with Youngquist and Braun (26) there is a general opinion that urovagina is not a widespread disorder; however, Gonzales-Martin et al. (14) define urovagina as an important cause of infertility in cows. In the study of Gautam and Nakao (10) the prevalence of urovagina varied between 4.4 and 26.7%.

In our study 36 out of 1167 cows showed signs of urovagina which yields a prevalence of 3.1%. The aforementioned studies determined the prevalence of urovagina within a special population with diseases, so a direct comparison of ratios is not possible. However, calculations from the data in several studies (8, 23, 25) reveal a prevalence of urovagina among the entire breeding cow population between 1.5% and 2.6% which is still lower than found in this study. Examinations during routine insemination procedures may not be sufficient to detect all urovagina cases because in mild cases rectal examination prior to vaginoscopic examination may

Table 1
Summarized bacteriological results of the uterine samples in cows.

<table>
<thead>
<tr>
<th>Microorganism</th>
<th>Isolates n (%)</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cows with pneumo- and/or urovagina</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Escherichia coli</em></td>
<td>88 (37.9)</td>
<td>7 (16.3)</td>
</tr>
<tr>
<td><em>Streptococcus bovis</em> II group D</td>
<td>36 (15.5)</td>
<td>5 (11.6)</td>
</tr>
<tr>
<td><em>Streptococcus bovis</em> I group D</td>
<td>30 (12.9)</td>
<td>4 (9.3)</td>
</tr>
<tr>
<td><em>Streptococcus equinus</em></td>
<td>17 (7.3)</td>
<td>2 (4.7)</td>
</tr>
<tr>
<td><em>Staphylococcus haemolyticus</em></td>
<td>5 (2.2)</td>
<td>1 (2.3)</td>
</tr>
<tr>
<td><em>Enterococcus casseliflavus/gallinarum</em></td>
<td>8 (3.4)</td>
<td>1 (2.3)</td>
</tr>
<tr>
<td><em>Streptococcus acidominimus</em></td>
<td>3 (1.3)</td>
<td>1 (2.3)</td>
</tr>
<tr>
<td><em>Bacillus licheniformis</em></td>
<td>3 (1.3)</td>
<td>1 (2.3)</td>
</tr>
<tr>
<td><em>Proteus mirabilis</em></td>
<td>6 (2.6)</td>
<td>–</td>
</tr>
<tr>
<td><em>Bacillus cereus</em></td>
<td>–</td>
<td>3 (7.0)</td>
</tr>
<tr>
<td><em>Enterococcus hirae</em></td>
<td>5 (2.2)</td>
<td>1 (2.3)</td>
</tr>
<tr>
<td><em>Citrobacter koseri</em></td>
<td>3 (1.3)</td>
<td>–</td>
</tr>
<tr>
<td><em>Candida spp.</em></td>
<td>2 (0.9)</td>
<td>3 (7.0)</td>
</tr>
<tr>
<td><em>Enterococcus faecium</em></td>
<td>3 (1.3)</td>
<td>–</td>
</tr>
<tr>
<td><em>Bacillus spp.</em></td>
<td>4 (1.7)</td>
<td>2 (4.7)</td>
</tr>
<tr>
<td>Other bacteria (&lt; 2%)*</td>
<td>19 (8.2)</td>
<td>12 (27.9)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>232 (100)</td>
<td>43 (100)</td>
</tr>
</tbody>
</table>

* Bacillus megaterium, Bacillus pumilus, Gemella morbillorum, Enterococcus faecalis, Streptococcus uberis, Streptococcus mitis, Comamonas testosteroni, Arcanobacterium heamolyticum, Aerococcus viridans, Bacillus subtilis, Bacteroides (Capillosus), Lactobacillus fermentum, Staphylococcus capitis spp. ureolyticus, Trueperella pyogenes, Escherichia fergusonii
provoke outflow of small amounts of urine from the vagina which might be supposed as normal urination. So, there might be no urine in the vagina anymore during vaginoscopic examination. We assume that mild cases can easily be overlooked and with extensive examination obviously much more cases with urovagina can be diagnosed.

All previously mentioned studies evaluated pneumovagina and urovagina independently as separate disorders; however, in our material all 36 cows (3.1%) with urovagina had signs of pneumovagina. This might be explained by the increased negative abdominal pressure after parturition which causes a craniad sinking of the anus and subsequently of the vagina with increased cranial angulation of the dorsal portion of the vulva in predisposed animals. Air sucking in severely affected animals additionally triggers a reflux of urine from the vestibule to the vagina which results in urine accumulation in the lower part of the vagina.

Gautam and Nakao (10) reported that a low BCS increased the risk for urovagina. There was no statistically significant difference between cows with pneumovagina and controls concerning BCS. However, a statistically significant difference between control animals and cows with urovagina with respect to BCS (p < 0.001) could be found, if cows with urovagina were evaluated separately.

In the present study only 12.5% of cows with pneumovagina had a BCS below 2.5 and the BCS’s of the remaining population were within normal ranges comparable with those of other studies (3, 11, 16). It was concluded that a low BCS could be a contributing factor increasing risk and severity of pneumovagina especially in cases complicated with urovagina but, contrary to our expectations, BCS is not the solitary and main reason for the development of pneumovagina. In other words, pneumovagina can also occur in cows with normal BCS. The authors supposed that lack of a significant difference between groups concerning BCS could be due to a long infertility period and advanced lactation stage in the applied herds in which BCS already raised again. The authors suppose that after the expulsion of the calf and evacuation and involution of the uterus the volume of the abdominal content decreases rapidly. During lactation animals are usually fed with low quantity and the ventil effect of the vestibule is disturbed fecal material and intestinal fluids may easily enter the vestibule and vagina facilitated by gravity.

Another accompanying clinical finding of pneumovagina and/urovagina was a persistent vulvar aperture which was encountered in 17 cases (7.6%). There was no significant difference between groups concerning vulvar closure. This sign was assumed to be one of the most important predisposing factors for uterine infections, however, its prevalence in our material is low. Insufficient vulvar closure can occur due to previous traumatic tissue losses and scars but sometimes especially the dorsal commissure is inverted and deformed by the negative intraabdominal pressure.

In 29 cows with pneumovagina (13%) perineal atrophy could be detected. The authors believe that this finding is one of the most characteristic features of pneumovagina and is encountered in individuals with a low BCS. Perineal atrophy and craniad sinking of the anus did not occur in cows of the control group (p < 0.05).

Cases with mild or moderate clinical pneumovagina become evident only during estrous. In severe cases air in- and outflow can also be determined during other phases of the sexual cycle. It has been concluded that foamy discharge which has not been mentioned in the literature before and has been observed in cows with pneumovagina during estrous (77.7%) is a pathognomonic symptom for pneumovagina.
Passive flow of urine during rectal examination should be considered as a sign for uro vagina. Since all 36 animals having urovagina also showed signs for pneumovagina it is suggested that both disorders are related to each other and should be considered as a urovagina-pneumovagina complex. Despite uterine involution in the postpartal period, involution of abdominal muscles and abdominal wall is only limited which might lead to a high intra-abdominal volume and negative abdominal pressure. This is considered to predispose to or even cause pneumovagina especially in cows with perineal atrophy and conformation faults.

In a study on infertility associated with clinical and subclinical endometritis in cows (20) the most frequently isolated organisms from uterine swabs were E. coli and Arcanobacterium pyogenes while E. coli has a synergistic effect on many bacteria which exacerbates uterine infection. Especially after parturition E. coli is the most common bacterium isolated from uterine samples (19). It has been reported that bacteria with enteral origin especially E. coli are with a proportion of 43.8% the most encountered agents in cows with pneumovagina in contrast to other organisms (13). In the present study, again, E. coli was the most frequently isolated organism. Isolation of bacteria of enteral origin from the uterus and a turbid vaginal discharge in these animals provide evidence for ascending infections causing infertility problems due to pneumovagina and/or urovagina. Studies (1, 5) on bitches found that E. coli has an affinity to the urogenital system due to uropathogenic virulence factors (UVP) such as pap, sfa, hlyA, cnF1 and fim. In another study (13) E. coli had a much higher occurrence in cows with pneumovagina compared to other cows with fertility problems. The authors deduced that in cows with pneumovagina bacteria of enteral origin and organisms around the perineal region enter the genital canal by mechanical effects, settle down in the uterus facilitated by uropathogenic factors and cause endometritis. This theory may explain why E. coli is overrepresented in uterine swabs of cows with pneumovagina.

As a conclusion, the prevalence of pneumovagina in cows is as high as 19.2% which is much higher than published before. Urovagina has a prevalence of 3.1% and is always an accompanying sign in severe cases of pneumovagina. Foamy vulvar discharge during estrus can be regarded as a pathognomonic and early sign of pneumovagina also in very mild cases. Pneumovagina causes a high rate of uterine infection with bacteria of enteral origin. Affecting factors for the development of pneumovagina and/or urovagina and which role pneumovagina and/or urovagina play in fertility problems of cows have to be investigated in further studies.

Acknowledgements
The authors are grateful to the farmers of the Marmara region, to TIGEM administration and to the workers of the Dairy Unit of TIGEM Karacabey Agricultural Farm for their cooperation and also to Ender Carkunoguz for the statistical analyses.

Conflict of interest
None of the authors of this paper has a financial or personal relationship with other people or organisations that could inappropriately influence or bias the content of the paper. This study was supported by the Scientific Research Project Centre of Uludag University (YIOMYO2008/59).

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G. Goncagul et al.: Prevalance of pneumovagina in cows


Rezension

NutztierSkills – Arbeitstechniken in der Großtierpraxis, Rind Schwein, Schaf, Ziege

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