

The influence of infection in the urinary tract of sows on arthritis, facial lesions and weight gain in suckling piglets

Infecção urinária em fêmeas suínas influencia a ocorrência de artrite, lesões faciais e ganho de peso em leitões lactentes

La infección del tracto urinario en cerdas influencia el surgimiento de artritis, lesiones faciales y en la ganancia de peso en lechones lactantes

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Abstract

Urinary tract infection (UTI) is a common disease in sows, it influences their yield and can also affect piglets. There is a small number of studies in the literature reporting close correlation between UTI in sows and disease development or reduced performance in piglets. Therefore, the aim of the present study is to test whether UTI in pregnancy influences disease development and the growth performance of suckling piglets. Healthy sows, presenting parity 1 to 4, were divided into two groups: UTI (+) (36 sows with UTI) and UTI (-) (36 sows without UTI). After delivery, piglets were monitored for diarrhea, omphalitis, arthritis and facial lesions. Average weaning weight (AWW) was calculated to measure growth performance. There was no difference in diarrhea and omphalitis between groups. However, parity 3 sows and all-parity analyses showed higher frequency of piglets with arthritis and facial lesions. The UTI (+) group showed lower AWW than the UTI (-) group in parity 4 sows and in all-parity analyses applied to growth performance. In conclusion, UTI in sows during pregnancy is a risk factor for arthritis and facial lesions in suckling piglets, as well as has negative effect on their growth performance.

Keywords: Cystitis; Newborn piglet; Pig; Swine; Weight gain.

Resumo

O objetivo deste estudo foi testar se a infecção urinária (IU) em fêmeas suínas gestantes influencia na ocorrência de algumas doenças e no ganho de peso de leitões lactentes. Porcas aparentemente saudáveis, com ordem de parto (OP) de um a quatro, foram divididas em dois grupos: grupo UTI (+) (36 porcas positivas para IU) e grupo UTI (-) (36 porcas negativas para IU). Após o parto das fêmeas, os leitões foram monitorados quanto à ocorrência de diarréia, onfalite, artrite e lesões faciais. Para medir o ganho de peso, foi calculado o peso médio ao desmame (PMD). Não houve diferença entre os grupos para diarréia e onfalite. No entanto, porcas da OP três e a análise de todas as OP juntas mostraram maior frequência de leitões com artrite e lesões faciais. Quanto ao ganho de peso, o grupo IU apresentou PMD menor que o grupo sem IU nas fêmeas de OP quatro e na análise de todas as OP juntas. Concluímos que

a IU em fêmeas suínas gestantes é um fator de risco para a ocorrência de artrite e lesões faciais em leitões lactentes, bem como um fator que afeta negativamente o ganho de peso dos leitões.

Palavras-chave: Cistite; Ganho de peso; Leitão recém-nascido; Matriz suína; Suínos.

Resumen

El objetivo de este estudio fue probar si la infección del tracto urinario (ITU) en cerdas durante la gestación gestantes influye en la aparición de algunas enfermedades y en la ganancia de peso de los lechones lactantes. Las cerdas aparentemente sanas, con orden de parto (OP) de uno a cuatro, fueran divididas en dos grupos: grupo UTI (+) (36 cerdas ITU positivas) y grupo UTI (-) (36 ITU negativas). Después del parto de las cerdas, se observó a los lechones para detectar diarrea, onfalitis, artritis y lesiones faciales. Para medir la ganancia de peso, se calculó el peso medio al destete (AWW). No hubo diferencias entre los grupos para la diarrea y la onfalitis. Sin embargo, las cerdas con OP tres y el análisis de todas las cerdas de todas las OP juntas, mostró una frecuencia más grande de lechones con artritis y lesiones faciales. A cerca de la ganancia de peso, el grupo UTI (+) mostró menor AWW que el grupo UTI (-) en cerdas con OP cuatro y en el análisis de las cerdas de todas las OP juntas. Concluimos que la ITU en cerdas gestantes es un factor de riesgo para la aparición de artritis y lesiones faciales en lechones lactantes; y además de eso, es un factor que influye de manera negativa en la ganancia de peso de los lechones.

Palabras clave: Aumento de peso; Cerda; Cistitis; Lechón recién nacido; Porcinos.

1. Introduction

Urinary Tract Infection (UTI) in sows is a chronic multifactorial disease affecting their reproductive health. It can be associated with mastitis-metritis-agalactia syndrome, abortions, anestrous, and litter size reduction (Sobestiansky et al., 1991; Bellino et al., 2013; Biksi et al., 2002).

There are few studies about UTI prevalence rate worldwide. A European report indicated that UTI affects from 22% to 40% of sows (Martineau & Almond, 2008). This rate ranges from 29% to 41% of sows in Brazil (Moura et al., 2018; Alberton et al., 2000).

The way UTI affects sows' life is already known; however, a sick sow impairs piglets' performance, mainly if the disease manifests in prepartum and postpartum time. Sick sows

may have problems with colostrum and milk production. If one takes into consideration that milk is the main diet of piglets in their first weeks of life, reduced milk yield is a limiting factor for piglets' growth performance, and it may result in piglets with low weaning weight (Morés et al., 1998; Silva et al., 1998; Le Dividich et al., 2005).

Animals with low weaning weight will not have the same growth performance of piglets who recorded adequate weaning weight. When there are many sows with UTI in a herd, litter uniformity may decrease, the number of weak piglets may increase and, consequently, there will be a delay in marketing weight. All these factors cause economic losses to farmers (Furtado et al., 2007). Furthermore, colostrum yield decrease impairs the intake of antibodies by piglet, and it affects the proper functioning of passive immunity, which is essential for piglet's health at farrowing stage (Le Dividich et al., 2005; Poonsuk & Zimmerman, 2017).

Moreover, sows with UTI release pathogenic microorganisms through the urine which is challenging since it can boost pen's contamination. Such a process is also a health challenge for piglets, since reduced ingestion of maternal antibodies may increase the prevalence of diseases caused by these pathogens in them (Sobestiansky, 2012).

There are a few numbers of studies in the literature reporting close correlation between UTI in sows and disease development or reduced performance in piglets. There is also lack of updated information in the overall scenario of UTI in pigs. Then, the aim of the present study was to test whether UTI in pregnant sows has any effect on disease development or growth performance in suckling piglets.

2. Methodology

The study was conducted under field conditions at a pig farm in Goiás State, Midwestern Brazil. The herd had 2,400 sows, all free of Aujeszky's disease, tuberculosis, sarcoptic mange, progressive atrophic rhinitis, enzootic pneumonia, swine dysentery, porcine pleuropneumonia and leptospirosis. Diagnosis tests for these diseases are performed every six months based on recommendation by the Brazilian Ministry of Agriculture and Livestock (MAPA).

Sows allocated in farrowing barn were selected for the study. They were individually housed in farrowing crates equipped with individual feeder and drinking troughs and had access to food and water *ad libitum*. In total, 125 parity 1 to 4 sows were selected; they seemed healthy, with no other joint, mammary gland and skin issues. All selected sows were at

final pregnancy stage, and three to five days prior to farrowing date. The first urine of the day of the sows was collected on the day after they were taken to the farrowing barn, just before feed intake (Menezes, 2001; Sobestiansky et al., 2012).

Samples were sent to the experimental laboratory set up in the farm right after urine collection. First, urine samples were tested for odor, color and clarity. Urine test strip (Urofito® 10DL – Prodimol Biotecnologia S/A, Brazil) was used for pH quantification and for qualitative nitrites, protein and blood identification - these parameters are known to change when sows are UTI positive (Strasinger, 1998; Mazutti et al., 2013). Another test was performed in case of negative nitrite, it used three drops of 5% potassium nitrate solution in 5 ml of urine. Nitrite presence was retested after incubation at 37°C for four hours by using the urine test strip. Sows were classified as UTI positive when urine presented ammonia odor and was positive for nitrites or blood (Alberton et al., 2000; Pôrto et al., 2003; Sobestiasnky et al., 1995).

Although urine culture test is an accurate method to UTI diagnosis, it takes at least one week to be fully completed, so it was not adequate to the herein adopted study design, since it needed an accurate and rapid result (Agência Nacional De Vigilância Sanitária, 2010).

After testing the 125 selected sows, only 72 composed the final sample. The selected sows were randomized in two experimental groups based on the presence or absence of UTI and on parity (Table 1).

Table 1. Experimental groups classified based on urinary tract infection and parity.

Parity	Number of animals	
	UTI positive sows UTI (+)	UTI negative sows UTI (-)
1	9	9
2	9	9
3	9	9
4	9	9
Total	36	36

UTI = urinary tract infection; UTI (+) = urinary tract infection positive sows Group; UTI (-) = urinary tract infection negative sows Group.
Source: Authors.

Sows were followed-up on a daily basis until the first farrowing symptoms, and 24 hours after farrowing. In total, 406 piglets were born from UTI (+) sows and 403 from UTI (-) sows. Piglets were cross-fostered by respecting groups and parity (e.g., piglets born from parity 2 UTI (+) sows were only mixed to other parity 2 UTI (+) sows).

Diarrhea, omphalitis, arthritis and facial lesions were observed on a daily basis in order to evaluate disease development in piglets. The whole litter was set as one experimental unit to assess diarrhea cases in the pen, because it usually happens in more than one piglet, it often affects the whole litter. Each piglet was set one experimental unit to assess the other parameters.

Average weaning weight (AWW) was measured to assess piglets' growth performance. Piglets in the same litter were jointly weighed on weighing hook scale right after cross-fostering and at weaning day at the age of 21 days. Then, litter AWW was calculated (Bollwahn, 1965; Souza et al., 2012).

Software Prism 8 (GraphPad Software Inc, United States of America) was used for statistical analysis. Chi-square test, with Yates correction, was applied to diarrhea, omphalitis, arthritis and facial lesion data. Student's T test was applied to analyze AWW. Sows were analyzed by taking into account each parity and all-parity. P-value lower than 0.05 ($p < 0.05$) was statistically significant.

3. Results

3.1. Diseases in suckling piglets

All the results regarding diarrhea, omphalitis, arthritis, and facial lesions are shown in Table 2.

Table 2. Diarrhea, omphalitis, arthritis, and facial lesion frequency in piglets in experimental groups.

Parity	Diarrhea			Omphalitis		
	UTI (+)	UTI (-)	P-value	UTI (+)	UTI (-)	P-value
1	5 (55.5%)	4 (44.4%)	0.637	1 (0.98%)	1 (0.97%)	0.994
2	6 (66.6%)	2 (22.2%)	0.058	4 (3.96%)	5 (4.80%)	0.767
3	3 (33.3%)	6 (66.6%)	0.157	9 (9.27%)	3 (3.06%)	0.071
4	2 (22.2%)	5 (55.5%)	0.147	5 (4.85%)	5 (4.95%)	0.975
All-parity	16/36 (44.4%)	17/36 (47.2%)	0.813	19/403 (4.71%)	14/406 (4.44%)	0.363

Parity	Arthritis			Facial lesion		
	UTI (+)	UTI (-)	P-value	UTI (+)	UTI (-)	P-value
1	7 (6.86%)	4 (3.88%)	0.344	5 (4.90%)	4 (3.88%)	0.722
2	7 (6.93%)	7 (6.73%)	0.955	14 (13.86%)	6 (5.76%)	0.051
3	5 (5.15%)	0 (0%)	0.023	13 (13.40%)	4 (4.08%)	0.021
4	12 (11.65%)	6 (5.94%)	0.151	4 (3.88%)	3 (2.97%)	0.720
All-parity	31/403 (7.69%)	17/406 (4.18%)	0.035	36/403 (8.93%)	17/406 (4.18%)	0.006

The bold numbers are the ones that registered statistical differences.

UTI (+) = urinary tract infection positive sows Group; UTI (-) = urinary tract infection negative sows Group. Statistical test: Chi-square test with Yates correction. Statistical significance at $p < 0.05$.

Course: Authors.

There was no statistical difference in diarrhea and omphalitis between UTI (+) and UTI (-) groups, at any parity or at all-parity.

The UTI (+) group had more piglets with arthritis than the UTI (-) group at parity 3 sows ($p=0.023$) and at all-parity analysis ($p=0.035$) (Table 2). Parity 3 ($p=0.021$) and all-parity sows ($p=0.006$) accounted for higher facial lesion frequency in piglets in the UTI (+) group.

3.2. Growth performance of piglets

The data regarding growth performance of the piglets is shown in Table 3.

Table 3. Average weaning weight (AWW) recorded for piglets in the in experimental groups.

Parity	UTI (+)		UTI (-)		P-value
	AWW	SD	AWW	SD	
1	6.249	0.683	6.909	0.734	0.065
2	6.797	0.595	6.918	0.816	0.723
3	5.990	0.690	7.339	1.008	0.134
4	5.990	0.858	7.120	0.570	0.004
All-parity	6.433	0.759	7.072	0.783	<0.001

The bold numbers are the ones that registered statistical differences.

AWW = Average weaning weight; SD = Standard Deviation. UTI (+) = urinary tract infection positive sows Group; UTI (-) = urinary tract infection negative sows Group.

Statistical test: Student's T test. Statistical significance at $p < 0.05$.

Source: Authors.

Piglets in the UTI (-) group, at parity 4 and at all-parity analysis, recorded greater AWW than the ones in the UTI (+) group.

4. Discussion

Assumingly, UTI in sows would influence all disease parameters evaluated in piglets. However, only arthritis and facial lesions presented significant difference when the UTI (+) and UTI (-) groups were compared to each other.

Diarrhea has complex etiology in suckling piglets and can be caused by one, or more, infectious agents. Some other risk factors such as inadequate handling and poor hygiene can increase the risk of diarrhea outbreaks (Morés et al., 1991). Omphalitis is associated with bad umbilical-cord handling, lack of sanitary break and with poor hygiene in the pen (Silva et al., 1998; Furtado et al., 2007). UTI in sows may increase pathogenic microbial load in the pen, mainly of *Escherichia coli* and *Staphylococcus* sp., which are the two most prevalent bacteria causing UTI in sows (Bellino et al., 2013; Radeloff et al., 2010). However, since the prevalence of diarrhea and omphalitis cases in animals in the UTI (+) group did not increase, the current study has evidenced that UTI is not a risk factor for diarrhea and omphalitis in piglets.

So far, piglet arthritis has been associated with bad pig-production facilities, such as the ones with abrasive and uneven flooring (Furtado et al., 2007). However, there was higher frequency of arthritis in piglets in the UTI group likely due to increased microbial load in the pens of UTI sows. Thus, the current study is the first to show the correlation between UTI in sows and arthritis in suckling piglets; therefore, UTI can be considered a risk factor for this disease.

The UTI (+) group showed higher frequency of piglets with facial lesions than the UTI (-) group. This outcome seems to be associated both with low milk yield by UTI (+) sows and with increased microbial load in the pen of UTI (+) sows. Low milk yield may increase competition and the fight behavior among littermates and, consequently, facial lesion rates (Amaral et al., 2000; Meyer, 2005). Furthermore, the larger number of microorganisms in the pen of UTI (+) sows assumingly facilitated the occurrence of primary facial lesions due to competition among piglets.

Nevertheless, despite rising the frequency of diseases in piglets, UTI in sows also has negative impact on the growth performance of suckling piglets. Glock & Bilkei (2005) observed that UTI (+) sows and higher parity generated piglets with lower weaning weight as the consequence of decreased milk yield - piglets did not take in enough milk. However, Meyer (2005) did not identify any difference in the growth performance of piglets born from positive or negative UTI sows, and this finding shows that UTI is not likely always a decisive factor for low piglet weaning weight.

5. Conclusion

UTI in pregnant sows is a risk factor for arthritis and facial lesions in suckling piglets, but it has no correlation to diarrhea and omphalitis cases in them. UTI also has negative influence on the growth performance of piglets. Further research is needed to provide a better understanding of why UTI positive younger sows have a lower influence on piglets' diseases and growth performance.

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