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Effect of Dystocia on Level of Antioxidants and Interleukins in Iraqi Cows

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Abstract

Background: Dystocia is one of the most important and prevalent reproductive disorders which causes considerable economic losses to the cattle industry due to calf morbidity and mortality as well as reducing of cow fertility, milk production, and survival.

Aim: This study aims to investigate the association of dystocia to the level of antioxidants and some anti-inflammatory markers.

Materials and methods: Totally, 90; 45 dystocia and 45 normally delivered, adult cows were selected from different areas in Al-Qadisiyah province. The samples of venous blood were collected and centrifuged to collect the sera that tested by specific-species quantitative ELISA to measurement of antioxidants (SOD, CAT, and GSH-PX), lipid peroxidase (MDA) and anti-inflammatory markers (IL-1 and IL-6).

Results: Overall, the dystocia cows were showed a significant reduction ($p<0.05$) in concentrations of CAT (1.529 ± 0.23 ng/ml), GSH-PX (5.422 ± 0.617 ng/ml), SOD (499.611 ± 53.142 pg/ml) and IL-6 (18.367 ± 1.57 pg/ml); while, significant elevation was seen in levels of MDA (222.111 ± 14.579 ng/ml) and IL-1 (114.433 ± 4.779 pg/ml) when compared to values of normally-delivered cows [CAT (4.149 ± 0.136 ng/ml), GSH-PX (14.927 ± 0.306 ng/ml), SOD (1184.056 ± 108.584 pg/ml), IL-6 (42.711 ± 1.631 pg/ml), MDA (53.661 ± 4.165 ng/ml) and IL-1 (36.161 ± 1.272 pg/ml)].

Conclusions: For our knowledge, this represents the first Iraqi study investigate the concentrations of antioxidants and anti-inflammatory markers in cows experiencing dystocia suggesting their importance in reproductive outcomes. However, the role of antioxidants and interleukins in the pathogenesis of dystocia is complex and multifaceted area of research. The continued investigation of the antioxidants and interleukin signaling pathways, their interactions with other factors, and the development of targeted therapeutic strategies hold great promise for improving the management and outcomes of dystocia.

Keywords: Reproductive disorders, Catalase (CAT), Enzyme-linked immunosorbent assay (ELISA), Glutathione peroxidase (GSH-PX), Interleukin (IL), Malondialchehyche (MDA), Superoxide dismutases (SOD)

Introduction

Dystocia, a term derived from the Greek words “dis” meaning difficult, and “tokos” meaning work, is a common problem facing dairy and beef producers worldwide (Simões and Stilwell, 2021). The condition refers to a difficulty in calving with incidence of serious consequences such as potential reproductive problems in cows, prolonged calving time and calf mortality (Abdella and Ahmed, 2016). However, many underlying causes, risk factors and management strategies are important to overall improving reproductive performance and herd welfare. These factors include mainly the environmental, maternal and fetal factors (Funnell and Hilton, 2016). Environmental factors that can increase the occurrence of dystocia involved poor management practices and housing conditions, and extreme weather conditions. For maternal factors, there were age, body position and pelvic size which might play a great role in occurrence of dystocia. Fetal factors compose abnormal fetal growth, large fetal size, and abnormal fetal position which contributed largely in difficult calving (Mazouni et al., 2006; Alijahan and Kordi, 2014; Jacobson et al., 2020; Mota-Rojas et al., 2020). Therefore, effective management strategies are of great importance to reducing the dangerous and consequences of dystocia such as early recognition and intervention of dystocia as well as appropriate management of the pregnant cow and calves during and post parturition to significantly improving of outcomes (Mee et al., 2013; Abera, 2017;

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Kebede et al., 2017). In addition, various technological tools have been developed and utilized to effectively contribute in identification and prevention of dystocia like precision livestock farming (Szenci et al., 2022; Tsaousioti et al., 2024).

Growing evidence suggests that oxidative stress might play a role in development of dystocia through impact on the antioxidant status of affected animals (Ghoneim et al., 2016; Jacobson et al., 2020). Oxidative stress defined as an imbalance between the productions of reactive oxygen species (ROS) and the ability of the body to neutralize them, and can directly and / or indirectly affect the cow performance and health (Celi, 2011; Surai et al., 2019; Jîtcă et al., 2022; Wahab et al., 2024). The imbalance in interleukin concentrations can contribute to development of dystocia by altering the normal progression of birth (Vallejo-Timarán et al., 2021). Recent studies have highlighted the importance of interleukin profiling in understanding the pathophysiology of dystocia (Gallo et al., 2023; Kissler and Hurt, 2023; Pan et al., 2024).

In Iraq, although dystocia occurs frequently in cows, no available studies have been recognized can describe the level of antioxidants and / or anti-inflammatory markers in cows undergo this condition. Therefore, this study aims to investigate the level of antioxidants (CAT, GSH-PX, and SOD), lipid peroxidase (MDA), and some anti-inflammatory markers (IL-1 and IL-6) in cows experiencing dystocia for first time in Iraq.

Materials and methods

Ethical approval

The Scientific Committee in the College of Veterinary Medicine (University of Al-Qadisiyah) gives the license to performing this study.

Study animals and samples

Totally, 90 adult cows including 45 with recent dystocia and 45 of normally-delivered, were selected from different areas in Al-Qadisiyah province. Under aseptic condition, 5ml of venous blood was drained from each cow into a labeled free-anticoagulant glass-gel tube. In laboratory, the tubes of blood were centrifuged at 5000rpm for 5 minutes, and the resulted serum was transferred into labeled 1.5ml Eppendorf tubes. All serum samples were kept frozen (-20°C) into darken plastic container until be tested serologically.

Serological measurement

Specific-species quantitative ELISA kits were served to measurement of antioxidants (SOD, CAT, and GSH-PX), lipid peroxidase (MDA) and anti-inflammatory markers (IL-1 and IL-6). Following the manufacturer instructions of each kit (SunLong Biotech, China), Standard, solution and sera were prepared, processed, and the ODs of Standards and sera of each kit were measured using the ELISA Microplate Reader (BioTek, USA). The concentrations of each marker were calculated by plotting the OD values of each Standard and serum samples on the log scales (x-axis and y-axis, respectively

Statistical analysis

All obtained data were tabled using the Microsoft Office Excel (version 2016) and analyzed statistically using the *t*-test in the GraphPad Prism Software (version 8.0.2). All values were represented as mean ± standard error (M ± SE), and differences between the values of the study groups were considered significant at $p<0.05$ (*), $p<0.01$ (**), $p<0.001$ (***), and $p<0.0001$ (****), (Gharban, 2024).

Results

In comparison to values of normally delivered cows (4.149 ± 0.136 ng/ml), the dystocia cows were showed a significant reduction ($p<0.05$) in concentrations of CAT (1.529 ± 0.23 ng/ml), (Figure 1).

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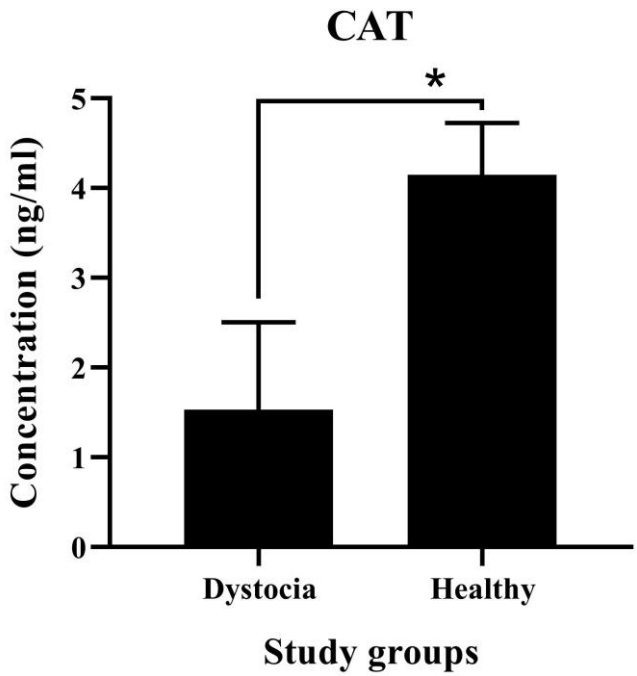
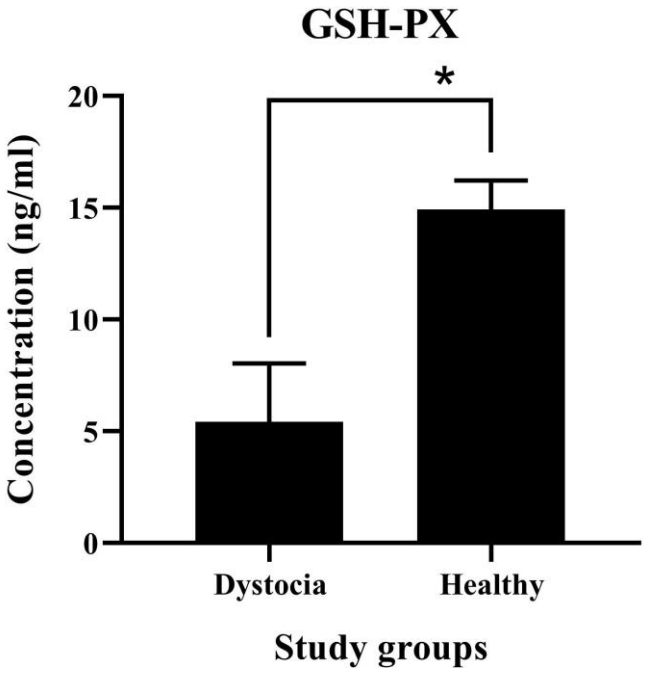


Group	M ± SE
Normal	4.149 ± 0.136
Dystocia	1.529 ± 0.23
p-value	0.0105 *
95% *CI*	13.81 to 19.48
R^2	0.8245

Figure (1): Concentration of CAT among the dystocia and normally delivered cows (Total No: 90)

Significantly, the findings of GSH-PX in dystocia cows (5.422 ± 0.617 ng/ml) were lower than observed in normally delivered cows (14.927 ± 0.306 ng/ml), (Figure 2).



Group	M ± SE
Normal	14.927 ± 0.306
Dystocia	5.422 ± 0.617
p-value	0.0278 *
95% *CI*	50.21 to 70.56
R^2	0.8209

Figure (2): Concentration of GSH-PX among the dystocia and normally delivered cows (Total No: 90)

For SOD concentration, there was significant reduction () in values of dystocia cows (499.611 ± 53.142 pg/ml) when compared to those of normally delivered cows (1184.056 ± 108.584 pg/ml), (Figure 3).

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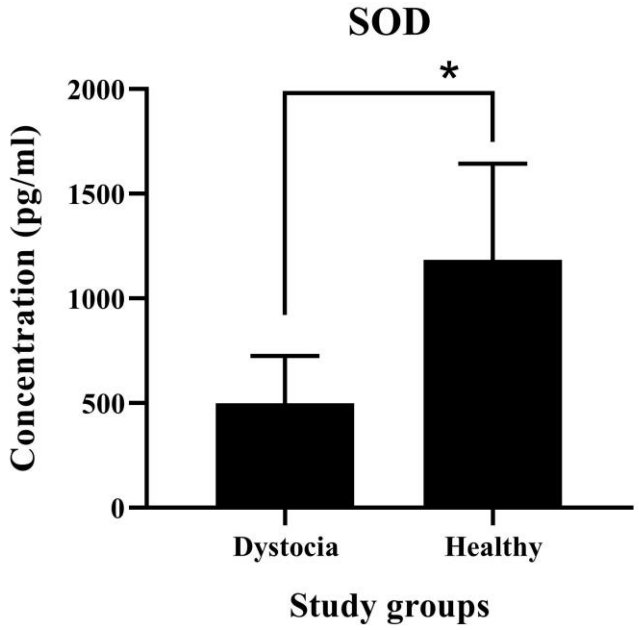
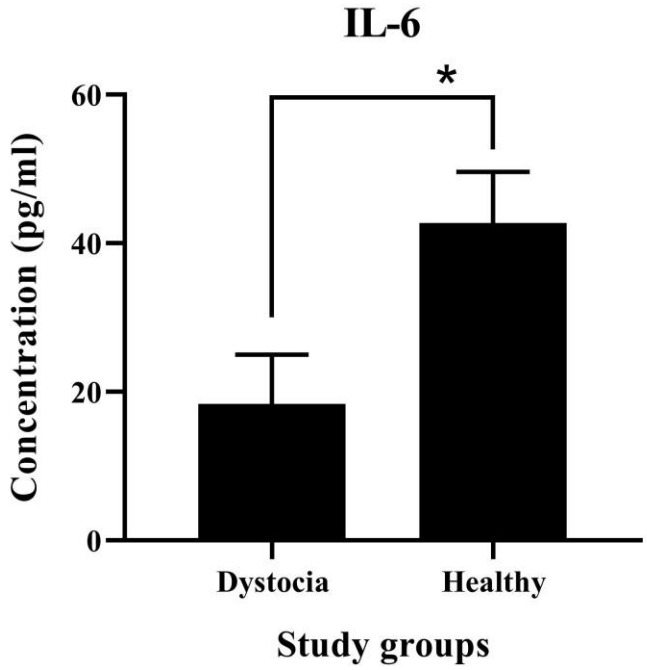


Group	M ± SE
Normal	1184.056 ± 108.584
Dystocia	499.611 ± 53.142
p-value	0.0316 *
95% *CI*	3507 to 5190
R^2	0.8582

Figure (3): Concentration of SOD among the dystocia and normally delivered cows (Total No: 90)

Concerning the levels of IL-6, the dystocia cows (18.367 ± 1.57 pg/ml) were showed a significant decrease in its values in comparison with those of the normally delivered cows (42.711 ± 1.631 pg/ml), (Figure 4).



Group	M ± SE
Normal	42.711 ± 1.631
Dystocia	18.367 ± 1.57
p-value	0.0241 *
95% *CI*	124.1 to 185.2
R^2	0.8629

Figure (4): Concentration of IL-6 among the dystocia and normally delivered cows (Total No: 90)

In dystocia cows, significant elevation was seen in MDA (222.111 ± 14.579 ng/ml) compared to values of normally delivered cows (53.661 ± 4.165 ng/ml), (Figure 5).

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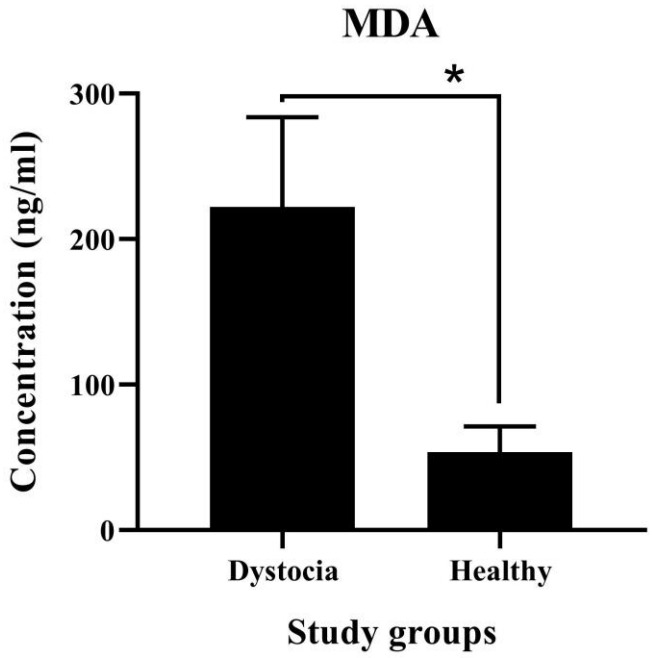
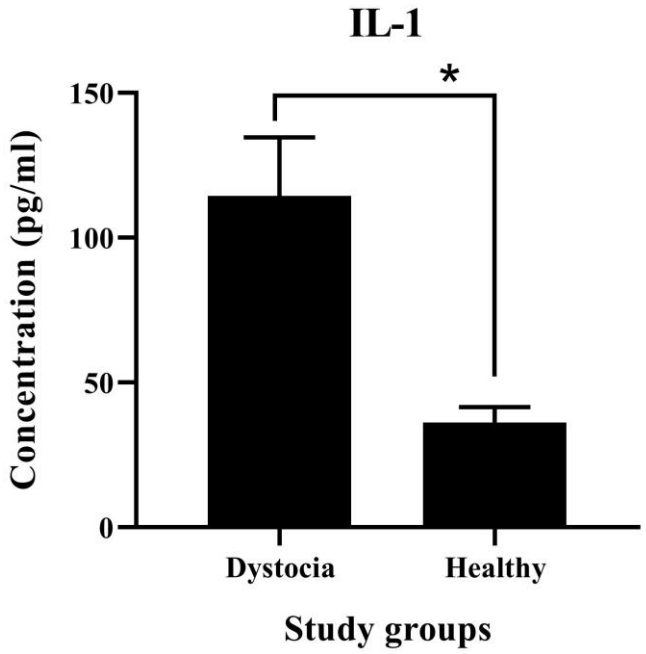


Group	M ± SE
Normal	53.661 ± 4.165
Dystocia	222.111 ± 14.579
p-value	0.0149 *
95% *CI*	932.3 to 1208
R^2	0.7283

Figure (5): Concentration of MDA among the dystocia and normally delivered cows (Total No: 90)

Regarding IL-1, there was a significant increase in values of dystocia cows (114.433 ± 4.779 pg/ml) in comparison with those recorded for normally delivered cows (36.161 ± 1.272 pg/ml), (Figure 6).



Group	M ± SE
Normal	36.161 ± 1.272
Dystocia	114.433 ± 4.779
p-value	0.0193 *
95% *CI*	422 to 572.6
R^2	0.7873

Figure (6): Concentration of IL-1 among the dystocia and normally delivered cows (Total No: 90)

Discussion

Cows represent an essential component of the agricultural industry as they play a vital role in providing different products for human consumption such as milk and its products and meat (Gharban and Yousif, 2020). However, various health problems can significantly impact the reproductive performance of a cow to result in dangerous consequences that affect the overall productivity and profitability of dairy farms (Saleem et al., 2021). Dystocia considers as one of the most reproductive health problem which negatively affecting cows and leading to increase calf mortality and delay breeding (Mekonnen and Moges, 2016). In dystocia cows, the findings of antioxidants (CAT, GSH-PX, and SOD) in this study found a significant reduction in their values with

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significant elevation in concentrations of lipid peroxidase (MDA). The observed decreases in total antioxidant activity of cows with dystocia suggest that oxidative stress might play as a contributed factor in development and progression of dystocia though the potential mechanisms underlying this association are not yet fully understood. This study hypothesized that the increased metabolic demands and tissue damage associated with dystocia may lead to depletion in the body antioxidant reserves, and the occurrence of oxidative stress. In the context of dystocia, oxidative stress may contribute to development of complications by altering the pathway of metabolic processes to impact on progression of birth and compromising the health status of calf (Rashid et al., 2013; Hussen et al., 2024). Other authors referred that decreasing antioxidants could lead to damage in cellular components such as membranes, proteins, DNAs and ultimately impairing the normal physiological functions of reproductive organs (Miller et al., 1993; Rashid et al., 2013; Mavangira and Sordillo, 2018). However, the exact role of antioxidants mitigating oxidative stress and its potential implications for dystocia have been the subject of several studies (Pisoschi et al., 2021; Rudrapal et al., 2022; Muscolo et al., 2024). One study showed that antioxidants overexpression can prevent tissue injury in animals subjected to circumstances that lead to generation of ROS such as hypoxia-reoxygenation or doxorubicin-induced cardiotoxicity (Kozakowska et al., 2015). Another meta-analysis study, on the use of flavonoids in diets of beef and dairy cattle, found that these compounds can improve the antioxidant status and reproductive performance (Orzuna-Orzuna et al., 2023).

Our findings found that the levels of anti-inflammatory markers could be varied significantly according to the health status of animals. In dystocia cows, while the concentrations of IL-1 increased significantly; the levels of IL-6 decreased significantly. One key factor contributing to the pathogenesis of dystocia is the role of inflammatory cytokines such as interleukins that play a crucial role in progression of parturition (Jaworska and Janowski, 2019; Al-Hetty et al., 2023; Al-Qahtani et al., 2024). The involvement of interleukins in the pathogenesis of preterm delivery, another contributing factor to dystocia, has also been investigated. Preterm delivery is often characterized by inflammation or infection which both could lead to releasing of pro-inflammatory interleukins in the cervix, placenta, and fetal membranes. These elevated levels of interleukins can disrupt the normal progression of birth and ultimately result in dystocia (El-Bastawissi et al., 2000; Sadowsky et al., 2006; Nadeau-Vallée et al., 2016; Pandey et al., 2017).

Conclusion

For our knowledge, this represents the first Iraqi study investigate the concentrations of antioxidants and anti-inflammatory markers in cows experiencing dystocia suggesting their importance in reproductive outcomes. However, the role of antioxidants and interleukins in the pathogenesis of dystocia is complex and multifaceted area of research. The continued investigation of the antioxidants and interleukin signaling pathways, their interactions with other factors, and the development of targeted therapeutic strategies hold great promise for improving the management and outcomes of dystocia.

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