FULL PAPER *Surgery*

Utility of ultrasonography for diagnosis of superficial swellings in buffalo (*Bubalus bubalis*)

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ABSTRACT. We studied 72 buffalo with superficial swellings in the head (n=4), neck (n=5), chest wall (n=4), abdominal wall (n=28), limbs (n=16), gluteal region (n=8), perineal region (n=6) and udder (n=1). Ultrasonographically, the swellings varied according to type, duration, content and location. The clinical use of ultrasound to assess these superficial swellings allowed diagnosis of abscesses (n=21), hematomas (n=11), hernias (n=17), bursitis (n=13), urethral diverticula (n=6) and tumors (n=4). Ultrasonography could precisely discriminate each lesion type (sensitivity, 71–100%; specificity, 75–100%; odds ratio, 1.0–8.4; Confidence Interval, 74.2–20; and *P* value 0.001). The specificity for ultrasonographic evaluation of superficial swellings was 100% for hernias, urethral diverticula and tumors, whilst the lowest specificity was recorded for hematomas (75%) and abscesses (92%). In conclusion, ultrasonography provides a precise, non-invasive and fast technique for the evaluation, classification and subsequent treatment of a variety of superficial swellings in buffalo.
KEY WORDS: buffalo, diagnosis, non-invasive, swelling, ultrasonography

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Buffalo *(Bubalus bubalis)* represent an important component of Egyptian livestock and make a significant contribution to the agricultural economy; producing milk, meat, hides and serving as draft animals. The importance of buffalo is also associated with their increased longevity, high dry content of their milk and a strong organic resistance, as compared with cows [8].

Superficial swellings, including abscess, hematomas, hernias, bursa, urethral diverticula and neoplasms commonly occur in buffalo [14, 15]. The correct clinical diagnosis of such swellings is usually made based on their physical location, palpation and needle aspiration biopsy. However, it is sometimes difficult to evaluate superficial swellings within the ventro-lateral abdominal wall by such routine clinical methods alone, because of their location, the massive size and temperament of the animal, and the pain associated with the lesion [21].

Differential diagnosis of such superficial swellings is challenging as several different types of swellings share similar clinical characteristics [3, 21]. Additionally, the different types of swellings require differential management, with misdiagnosis leading to unnecessary, painful procedures and/or an increase in risk to the animal, loss of time or cost to the owner [14, 15].

Ultrasonography has been suggested as a suitable methodology to provide accurate preoperative details regarding the extent and character of the superficial swellings being examined; it is able to distinguish fluid from solid accumulations and to guide fine needle aspiration or biopsies [15, 17]. Based on demonstrable interfaces and an altered echogenicity, ultrasonography can distinguish most space occupying soft tissue masses from the surrounding organs, when other clinical examinations are inconclusive [14, 23].

Many studies have assessed superficial swellings in bovines. However, few studies using ultrasonography have been conducted in buffalo. Several ultrasonographic differences have been recorded in buffalo as compared to other types of cattle. The thick skin of undomesticated buffalo may affect the ultrasonographic imaging of superficial swelling in these animals under field conditions. Therefore, the present study was designed to validate the use of ultrasonography in the early diagnosis of superficial swellings in buffalo as a means to improve diagnosis and clinical decision-making.

MATERIALS AND METHODS

Animals: We assessed 72 buffalo (43 females and 29 males) aged between 3 and 36 months (mean ± SD: 20 ± 4 months), and weighing between 70 and 500 kg (350 ± 50, mean ± SD). Animals were admitted to Mansoura Veterinary Teaching Hospital, Egypt, between January 2013 and September 2015. Buffalo were included in the study based on

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Table 1. Description of the location and duration of the superficial swellings assessed in the cohort of buffalo

Location	Abscess (n= 21)		Hematoma (n=11)		Hernia (n= 17)		Bursitis (n= 13)		Urethral Diverticulum (n= 6)	Tumor (n=4)
	Acute (n=8)	Chronic (n=13)	Recent (n= 7)	Organized (n=4)	Reducible (n= 12)	Irreducible (n=5)	Acute (n= 7)	Chronic (n= 6)		
Head (n=4)	1	2	0	0	0	0	0	0	0	1
Neck (n=5)	1	1	1	1	0	0	0	0	0	1
Chest wall (n=4)	1	0	0	0	0	0	2	1	0	0
Abdominal wall (n=28)	3	6	0	1	12	5	0	0	0	1
Forelimb (n=9)	0	0	1	1	0	0	4	3	0	0
Hindlimb (n=7)	0	1	2	1	0	0	1	2	0	0
Gluteal region (n=8)	2	3	3	0	0	0	0	0	0	0
Perineal region (n=6)	0	0	0	0	0	0	0	0	6	0
Udder (n=1)	0	0	0	0	0	0	0	0	0	1

Table 2. Clinical and ultrasonographic characteristics of superficial swellings studied in the cohort of buffalo

Parameters	Abscess (n=21)		Hematoma (n=11)		Hernia (n=17)		Bursitis (n=13)		Urethral diverticulum (n= 6)	Tumor (n=4)
	Acute (n=8)	Chronic (n=13)	Recent (n=7)	Organized (n=4)	Reducible (n=12)	Irreducible (n=5)	Acute (n=7)	Chronic (n=6)		
Size (mm)	57–90	79–150	69–120	93–162	51–129	36–83	33–109	15–82	112–169	56–104
Capsule thickness (mm)	8–24	4–12	4–17	2–11	5–8	9–13	8–11	6–14	7–15	5–7
Aspirated material										
Blood	8	0	7	0	0	0	0	0	0	4
Pus	0	13	0	0	0	0	4	0	0	0
Serosanguinous	0	0	0	4	0	0	0	0	0	0
Serous	0	0	0	0	0	0	3	4	0	0
Urine	0	0	0	0	0	0	0	0	6	0
Nothing	0	0	0	0	12	5	0	2	0	0
Echogenicity										
Anechoic	0	4	3	3	9	0	1	1	3	0
Hypoechoic	5	9	4	1	3	3	3	4	3	3
Echoic	3	0	0	0	0	2	1	0	0	0
Hyperechoic	0	0	0	0	0	0	2	1	0	1

clinical superficial swelling at different locations of the body. The size of each included swelling was measured using a tape measure. Descriptive details of the location and duration of the superficial swellings in all investigated buffalo are presented in Table 1. The study protocol was approved by the committee of animal welfare and ethics, Faculty of Veterinary Medicine, Mansoura University.

Ultrasonographic examination: Ultrasonographic examinations were carried out with the animal in the standing position, using a 7.0–10.0 MHz mechanical linear and 2.0–5.0 MHz curvilinear multifrequency scanner (Mindray DP-2200Vet., Mindray, Shenzhen, PR China). The area on each buffalo to be examined was prepared by clipping and shaving of the hair, followed by application of coupling gel (Ultragel, Medilab, Cairo, Egypt) over the swelling and the surrounding area. The transducer was moved dorsoventrally and craniocaudally starting from the healthy wall towards the swelling. When required, ultrasonography-guided aspiration was performed, after sedation of the animals in question with an intravenous injection of xylazine HCl (Xylaject 2% −ADWIA Co., EL Obour, Egypt) at 0.1 mg/kg (n=17). Ultrasonographic images of the swellings were evaluated in terms of the echogenicity of the contents, size, capsule thickness, duration and the relationship of the swelling with the surrounding tissues. Descriptive details of the size, capsule thickness, nature and echogenicity of the contents of the superficial swellings in all the investigated buffalo are presented in Table 2.

Statistical analysis: Statistical analyses were performed using GraphPad Prism statistical software program (GraphPad Prism for win. version 5.0, GraphPad Software Inc., La Jolla, CA, U.S.A.). Contingency table analysis was used to assess the efficacy of ultrasonography for diagnosis of superficial swelling in examined buffalo. Data were presented as sensitivity, specificity, *P* value, confidence interval, odds ratio, positive predictive value and negative predictive value. Results with a P value<0.05 were considered significant.

RESULTS

Of the 72 animals investigated, 21 were diagnosed with abscesses (8 acute and 13 chronic), 11 with hematomas (7 recent and 4 organized), 17 with hernias (12 reducible and 5 irreducible), 13 with bursitis (7 acute and 6 chronic), 6 with

Table 3. Statistical parameters for ultrasonographic discrimination of superficial swellings in the studied buffalo cohort

Swelling type	Sensitivity (%)	Specificity (%)	Odds ratio	Confidence interval (95%)	Positive value	Negative value	*P* value
Abscess vs. others	95	98	1	5.9–16.7	95	98	0.0001
Acute vs. chronic abscess	88	92	8.4	4.5–15.6	88	92	0.0005
Hematoma vs. others	91	98	6	34.63–10.4	91	98	0.0001
Recent vs. organized hematoma	88	75	2.1	1.0–45.9	88	75	0.0667
Hernia vs. others	100	100	3.9	74.2–20.0	100	100	0.0001
Reducible vs. irreducible hernia	93	95	3.3	1.4–9.9	93	95	0.0301
Bursitis vs. others	77	95	6.2	10.9–35.3	77	95	0.0001
Acute vs. chronic bursitis	71	100	2.9	1.1–73.2	71	100	0.021
Urethral diverticulum vs. others	100	100	1.7	31.58–94	100	100	0.0001
Tumor vs. others	100	100	1.2	21.8–69.7	100	100	0.0001

urethral diverticula and four with tumors. Ultrasonography could precisely discriminate each lesion type (Sensitivity, 71–100%; Specificity, 75–100%; Odds ratio, 1.0–8.4; Confidence Interval, 74.2–20; and *P* value, 0.001). The results presented in Table 3 show that, the highest specificity of ultrasonography for evaluation of the superficial swellings was 100% for hernia, urethral diverticula and tumors; whilst the lowest specificity was recorded for hematomas (75%) and abscesses (92%).

Ultrasonographically, the swellings were classified as acute/chronic, recent/organized and reducible/irreducible, according to the stage of inflammation, duration and cause, respectively. Superficial swellings were localized as follows: four in the head, five in the neck, four in the chest wall, 28 in the abdominal wall, 16 in the limbs, eight in the gluteal region, six in the perineal region and one in the udder. The abdominal wall was the most common location for superficial swellings in studied animals (28 cases), especially for hernias and abscesses, followed by the limbs (16 cases, Table 1).

Ultrasonographic appearance of abscesses was generally constant; the capsule appeared as an echogenic line, enveloping variably echogenic contents and separating them from the surrounding tissue. The echogenic character of abscess contents varied according to its duration. In eight cases, abscesses appeared hard on palpation, with the contents appearing ultrasonographically as a homogenous hypoechoic to echogenic structure creating a moderate degree of acoustic enhancement below the swelling. In terms of ultrasound profile, such cases were considered as an acute form, and abscess lancing was delayed until maturation (Fig. 1A and B). Conversely, chronic abscesses were diagnosed in 13 buffalo with doughy to soft swellings upon palpation. Ultrasonographic appearance of the contents of these swellings appeared more hypoechoic to anechoic with some echogenic septa (Fig. 1C and D). Ultrasound-guided needle aspiration was performed to provide further confirmation, and then, abscesses were lanced as a routine surgical intervention. Bacteriological examination of the aspirate revealed *Staphylococcus aureus*, *Streptococcus* spp. or, in some cases, *Corynebacterium* spp.

Hematomas were diagnosed in 11 buffalo with a history of exposure to trauma. The appearance of the swelling generally resembles that of the abscess capsule, but is less echogenic, whilst the contents differ according to the duration of the lesion. In recent hematomas (7 buffalo), fluid contents were hypoechoic to anechoic, particularly at the periphery of the swelling with echogenic septa dividing the swelling into small chambers detected toward its center. The previous cases were diagnosed ultrasonographically as recent hematoma, so surgical intervention was postponed until organization of the Hematomas occurred (Fig. 2A and 2B). However, scanning of additional four cases of organized hematoma prior to routine surgical treatment revealed increased echogenicity of the contents, thicker septa and decreased anechoic fluid contents with presence of some echogenic shreds (Fig. 2C).

Fig. 1. (A) 5.7 cm-sized submandibular acute abscess (arrow) in a 28-month-old female buffalo. (B) Ultrasonographic image of the swelling showing accumulation of homogenous echogenic contents inside the 21 mm-thick hyperechoic capsule. (C) Chronic abscess of the knee in a seven-month-old female buffalo. (D) Ultrasonographic image of the swelling, showing the accumulation of hypoechoic to anechoic contents with echogenic septa located inside the 9 mm-thick hyperechoic capsule.

Hernias were diagnosed in 17 buffalo (12 reducible and 5 irreducible). In reducible cases, ultrasonography revealed disruption of the abdominal wall continuity at the site of the defect, with longitudinal and transverse intestinal loops observed within the hernial sac. A characteristic peristaltic

Fig. 2. (A) 14.5 cm-sized hematoma (arrow) located in the left hip of a 30-month-old female buffalo. (B) Ultrasonographic image of this recent hematoma demonstrating the accumulation of hypoechoic contents separated by echogenic septa. (C) Ultrasonographic image of an organized hematoma in this case, illustrating increased echogenicity of the contents, thickened echogenic septa and decreased anechoic fluid contents. (D) Reducible umbilical hernia in a five-month-old female buffalo. (E) Ultrasonographic image of the lesion indicating the longitudinal intestinal loops within the hernial sac (i) located proximally to the abdominal wall. (F) Ultrasonographic image of irreducible hernia showing thickened hernial sac (h) and echogenic adhesions (white arrow) within the space between the abdominal wall and hernia sac.

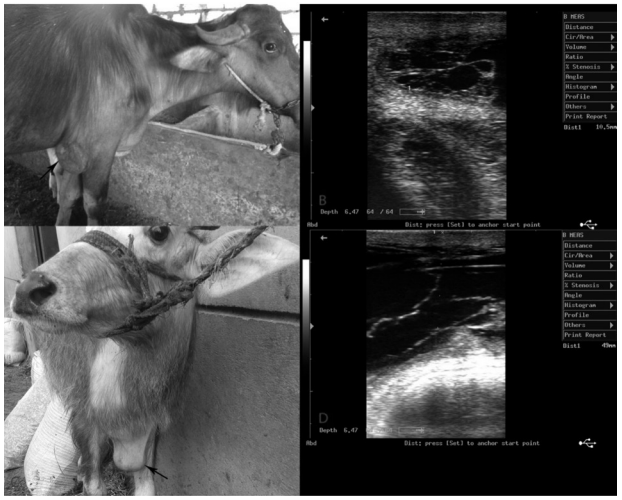

Fig. 3. (A, C) Clinical appearance of an 8.2 cm-sized olecranon cystic bursitis in a 36-month-old female buffalo, and a 5.3 cm-sized presternal cystic bursitis in a 3-month-old male buffalo, respectively. (B, D) Ultrasonographic images of these masses showing accumulation of hypoechoic to anechoic fluid contents separated by thinner echogenic fibrin septa within the thicker echogenic to hyperechogenic capsules (the lengths were 10.5 mm and 4.9 mm, respectively).

movement was also detected with anechoic, hypoechoic and echogenic contents, which represent fluid, ingesta and gases, respectively (Fig. 2D and 2E). A thickened hernial sac with echogenic adhesions between the abdominal wall and hernial sac was observed in irreducible hernias. Moreover, the peristaltic movement of intestinal loops was greatly reduced, and anechoic inflammatory exudates surrounding the intestinal loops and hernial sac were observed (Fig. 2F). Based on ultrasonographic evaluation, closed herniorraphy was applied to reducible hernias; whilst irreducible cases necessitated the use of the open technique for dissection of the hernial contents from the varying degrees of adjacent tissue adhesion before reduction.

Thirteen buffalo were diagnosed with bursitis at different body locations: olecranon (n=3); precarpal (n=5); presternal (n=4) or prestifle (n=1) bursitis. According to the duration and physical examination of bursitis, seven and six buffalo had acute and chronic bursitis, respectively. Fluid accumulation was detectable in all cases, with the exception of two buffalo with precarpal and prestifle bursitis, respectively. In cases where fluid accumulation was suspected, diagnostic centesis was applied. According to the characteristics of the fluid, bursitis was classified as sero-fibrinous (n=3), cystic (n=4), purulent (n=4) or fibrinous (n=2). Capsule echogenicity varied between hypoechoic in fluctuating swellings and hyperechoic in fibrous swellings with a mean capsule thickness of 4.9–12 mm. In some types of bursitis, hypoechoic free-floating particles representing blood cells, pus or fibrin masses were detected.

Ultrasonography of cystic bursitis revealed a thick hyperechogenic capsule (8.7–12 mm) surrounding hypoechoic to anechoic fluid content with the presence of thin echogenic fibrin septa (Fig. 3). However, ultrasound scanning of serofibrinous bursitis revealed a thick echogenic capsule enveloping thick echogenic fibrous masses with little hypoechoic fluid and hyperechoic floating particles. Ultrasound-guided centesis yielded a small amount of sero-hemorrhagic fluid (Fig. 4A and 4B). On the other hand, purulent bursitis was diagnosed with heterogeneous hypoechoic to anechoic content surrounded by a thin echogenic capsule (Fig. 4C and 4D). In addition, fibrous bursitis appeared as a fibrinous mass with heterogeneous echogenicity (Fig. 4E and 4F). Surgical intervention varied depending on the ultrasonographic identification of each type of bursitis: both drainage and intrabursal injections were used in cystic bursitis without fibrin clots, opening and curettage in purulent bursitis and radical excision for fibrinous bursitis.

Urethral diverticula were diagnosed in six buffalo. Physically, the lesions appeared as oval or circumscribed swellings in the perineal region, which began just distal to the anus (Fig. 5A). The size of such swellings varied according to the degree of infiltrate. Ultrasonographically, their appearance was uniform in all cases, with a well-demarcated thick

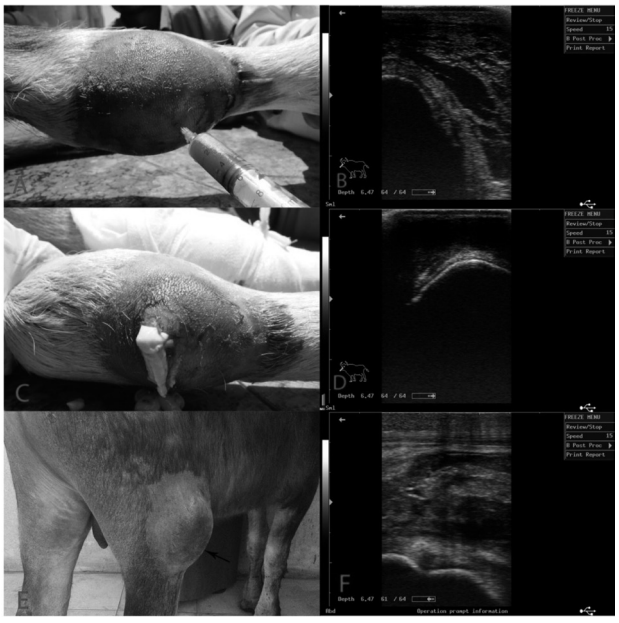

Fig. 4. (A) A 6.3 cm-sized serofibrinous bursitis on the precarpal surface of a 6-month-old male buffalo. (B) Ultrasonographic image of the swelling showing the accumulation of hypoechoic fluid and hyperechoic floating particles within the 8.2 mm-thick echogenic capsule. (C) 5 cm-sized purulent bursitis on the precarpal surface of a 6-month-old male buffalo. (D) Ultrasonographic image of the mass showing accumulation of heterogeneous hypoechoic to anechoic contents encapsulated within a 6.4 mm-thick echogenic capsule. (E) 7.6 cm-sized fibrous bursitis (arrow) on the outer side of the stifle joint of a 9-month-old male buffalo. (F) Ultrasonographic image of the mass showing accumulation of heterogeneous echogenic contents.

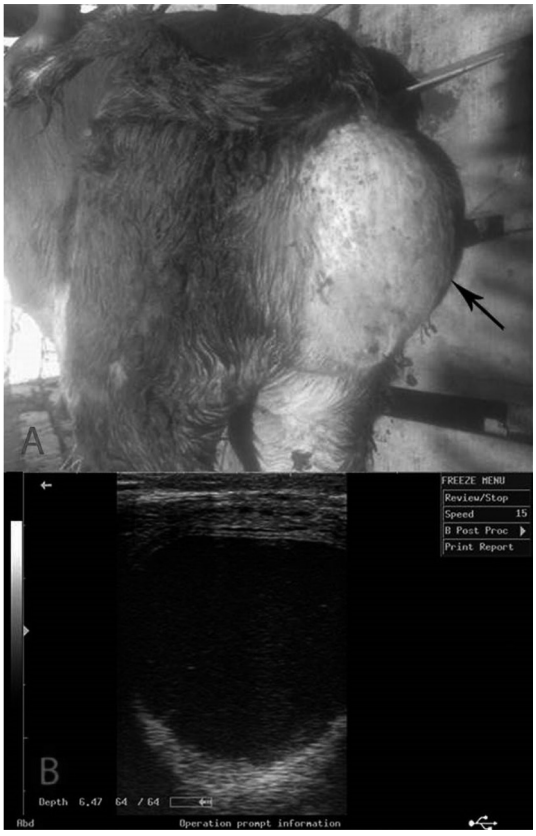

Fig. 5. (A) A 23 cm-sized and ovoid-shaped urethral diverticulum in the perineal region of an 8-month-old male buffalo. (B) Ultrasonographic image of the swelling showing urethral dilatation including homogenous anechoic to hypoechoic contents.

echogenic wall enveloping anechoic to hypoechoic fluid contents creating distal acoustic enhancement (Fig. 5B). The connection between the dilatation and the urinary bladder appeared as a narrow anechoic area with a demarcated wall. Ultrasound-guided needle aspiration ensures accurate diagnosis that is essential for appropriate surgical intervention.

Four buffalo were diagnosed with various types of tumors including osteosarcoma (at the right side of mandible), fibropapilloma (located in the udder), adenocarcinoma (located at the ventral aspect of the neck) and lipoma (located at the ventrolateral aspect of the abdomen). On palpation, the tumor mass had a mixed consistency, which varied from friable to solid. However, tumors appeared ultrasonographically as a round mass with an intensely hyperechoic acoustic shadow and of a diameter approximately 56–104 mm (Fig. 6). To the best of the authors' knowledge, mandibular osteosarcoma has not been previously reported in buffalo. Based on clinical and ultrasonographic examinations, radical excision of tumor was applied in all cases as a curative intervention.

DISCUSSION

Accurate diagnoses of superficial swellings in farm animals are routinely performed using a combination of case history and physical examination. However, the diagnosis is usually harder in buffalo than other types of cattle, because they have thicker skin and exhibit less signs of pain [22]. This makes clinical diagnosis more difficult and necessitates the use of additional noninvasive diagnostic imaging techniques to confirm the provisional diagnosis.

Early and accurate identification of superficial swellings is essential for successful management and effective recuperation of the affected animal. Diagnostic use of ultrasonography for buffalo with superficial swellings allowed differential diagnosis and preoperative planning for surgical intervention, and provided an accurate prognosis.

Ultrasonography is a relatively unique imaging modality for soft tissue structures of the buffalo's body. It provides a noninvasive, safe, rapid, simple, reliable and dynamic visualization for differential diagnosis in standing animals with a variety of different types of superficial swellings, when physical examinations are inconclusive [4, 15, 20]. The use of ultrasonography for observation and measurement of the shape, size and consistency of superficial masses, coupled with ultrasound-guided biopsy improves the clinicians' ability to provide accurate diagnoses [5, 9, 24, 25]. Linear array

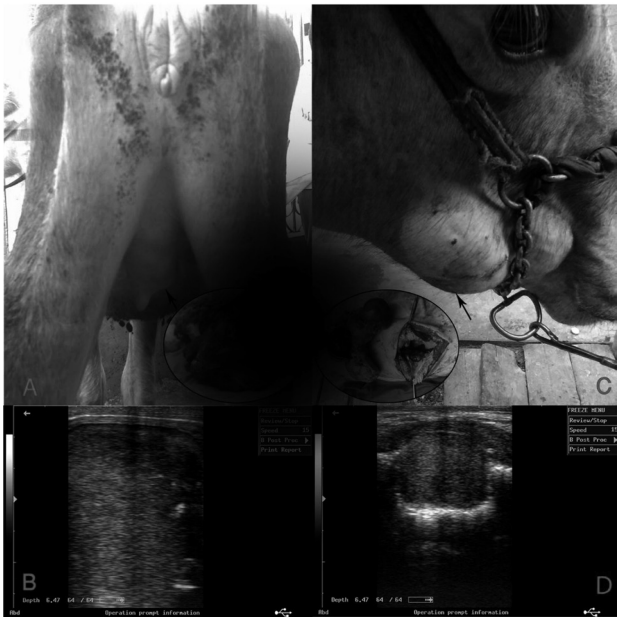

Fig. 6. (A) A 9.5 cm-sized fibropapilloma (arrow) behind the right hind teat of a 15-month-old female buffalo. (B) Ultrasonographic image of the mass showing a round hypoechoic mass. (C) 8.2 cm-sized osteosarcoma on the mandibular surface of a seven-month-old male buffalo. (D) Ultrasonographic image of the mass illustrating the homogenous echogenic structure surrounded by hyperechogenic wall of the mass with its associated acoustic shadow.

transducers provide improved resolution and are suitable for scanning any abnormal lumps or body wall swellings. They also distinguish skin from abdominal muscle, allowing for accurate measurement of swellings [4]. However, for assessing deeper lesions, 2.0 or 5.0 MHz curvilinear multi-frequency transducers should be used.

Regarding the nature of the fluid contents in the studied swellings, diagnoses made by physical examination and ultrasound closely corresponded with hernias, urethral diverticula and tumors. However, unlike physical examination, ultrasonography could also successfully differentiate between abscesses, hematomas and bursitis. Where, shreds of devitalized tissues in organized hematomas could not be detected using standard techniques. Bursitis in three buffalo was diagnosed as fibrous by physical examination, but ultrasonographically as serofibrinous. Moreover, two cases diagnosed as serous bursitis, were confirmed as purulent bursitis, based on ultrasonographic features and the characteristics of the aspirated fluid.

In this study, the degree of abscess maturation could not be determined by palpation alone, because of the thick skin of buffalo, a situation that could lead to misdiagnosis. Ultrasonographic echogenicity of a given abscesses' contents reflected its state of maturation [15, 18]. In the present study, ultrasonographic examination of abscesses allowed their accurate subdivision into acute and chronic, according to the variation in echogenicity of their contents. Ultrasonography revealed that the contents of acute abscesses were homogenously hypoechoic to echogenic structures, creating a moderate degree of acoustic enhancement below the swelling. However, in chronic abscess, the contents appeared more hypoechoic to anechoic with some echogenic septa.

Hematomas and abscesses are the most common disorders resulting from muscular trauma in large animals and are deceptively similar. Thus, their differential diagnosis represents a serious challenge, given their similarity on physical examination. In such instances, ultrasonographic evaluation of these swellings and their contents provides a reliable tool for their differential diagnosis [7, 9, 13]. In this study, the major difference in the ultrasonographic images of abscesses as compared to hematomas was the difference in their contents. The echogenicity of abscess' contents varied from hypoechoic to anechoic with echogenic septa; whereas hematomas' contents featured increased echogenicity combined with the presence of some echogenic shreds. Additionally, recent hematomas can be easily differentiated from organized ones by the ultrasound profile of their fluid content; recent hematomas have hypoechoic to anechoic fluid content that becomes more echogenic with thick septa as they become more organized.

Inflammatory abdominal wall swelling can be confused with abdominal wall hernia, because of the similar clinical features and history of acute onset. Ultrasound is extremely accurate in distinguishing hernias from other swellings without the need for the stress associated with casting, which has a high chance of causing self-inflicted injuries to the animal [27]. In our study, demarcation of the hernial ring and contents were easily observed by ultrasonography. The presence of more or less hypoechoic inflammatory exudates in recent hernias resembled that of abscesses under ultrasonographic examination. However, the clearly visible peristaltic movement of intestine within the hernia was particularly useful for their differential diagnosis [9, 18, 27]. Furthermore, hernioraphy, whether open or closed, depends on ultrasonographic evaluation of the intensity of peristaltic movement and degree of adhesion between the hernial sac and surrounding tissue.

Treatment selection for bursitis is determined by the capsule thickness, extent of inflammation and the contents of bursitis. In contrast to clinical diagnosis based on physical examination, ultrasonography provides a simple and precise evaluation of the characteristics and thickness of the bursitis capsule, its contents and the involvement of adjacent tissues [6, 10–12]. Different values of bursitis capsule thickness in this study were not always related to the swelling duration. This can be explained by increased capsule thickness due to edema in acute cases and fibrosis in chronic ones. Thus, from our point of view, capsule echogenicity was a more reliable parameter in categorizing bursitis, as bursae with signs of acute inflammation had an isoechoic to hypoechoic capsule, whilst hyperechoic capsules were observed mainly in chronic cases.

In the present study, urethral diverticula could be precisely diagnosed ultrasonographically as an anechoic to hypoechoic homogenous structure with a well-demarcated

wall and acoustic enhancement. However, the variation in the concentration of urine and concurrent diseases of the urinary tract, such as pyelonephritis or cystitis, could cause changes in echogenicity [2, 16].

Little information is available regarding tumor evaluation in buffalo. Different surveys indicate that the general incidence of tumors in buffalo is low, with osteosarcomas, basal cell carcinomas, adenocarcinomas, buccal capillary hemangiomas, buccal squamous cell carcinomas and rectal leiomyomas being reported [1, 19, 26]. In the present study, two animals had benign tumors (fibropapilloma and lipoma), and two had malignant tumors (osteosarcoma and adenocarcinoma). In comparison to physical examination of tumors in buffalo, ultrasonography provided reliable diagnostic and prognostic information. Ultrasonographic examination of the aforementioned tumors revealed a 56–104 mm diameter round mass with an intensely hyperechoic acoustic shadow. Similarly, ultrasonographic examination of neck tumors in cattle revealed a multi-chambered mass measuring 110 mm of the ventral neck [3].

In conclusion, ultrasonography provides a fast, precise, noninvasive technique for the evaluation, differentiation and subsequent clinical management of various types of superficial swellings in buffalo.

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