IJVS 2017; 12(2); Serial No:27

IRANIAN JOURNAL OF VETERINARY SURGERY (IJVS)
WWW.IVSA.IR

Original Article

Evaluation of ultrasonography in diagnosis of nasal fracture and its comparison with plain radiography in dogs

Siamak Alizadeh*, Ali Hayatrouhi

Abstract

Objective- One of the important causes of nasal fracture is a trauma that can be diagnosed in clinical examinations and diagnostic imaging but it should be noted that radiography may show false fractures in the nose. This study evaluated the value of ultrasonography in the diagnosis of nasal fractures and compared it to plain radiography.

Design- Retrospective study.

Animals- 12 dog patients with suspected nasal fracture.

Procedure- These dogs were evaluated by ultrasonography and radiography in comparison with the clinical examination (golden standard) and the results were analyzed by statistical method. Sensitivity, specificity, positive and negative predictive values, positive and negative odds ratio, and accuracy with 95% confidence intervals and the accuracy of both tests were calculated.

Results- In the diagnosis of nasal fracture by ultrasonography, sensitivity was 96.4%, specificity of 93.3% and accuracy of 96% and in the radiographic method, sensitivity, specificity and accuracy were 81.1%, of 86.7% 82%, respectively. In ultrasonography and radiography, the most sensitivity in diagnosis of nasal bridge fracture was 100% and 92.6% and the most specificity in diagnosis of the outer wall nasal fracture was 100% and 50%, respectively.

Conclusion and Clinical Relevance- According to the results of this study, ultrasonography could be used as a non-invasive method with high sensitivity and specificity in the diagnosis of nasal bone fractures in dogs.

Keywords: Nasal fracture, Ultrasonography, Radiography, Dogs.

Received: 24 December 2017; **Accepted:** 13 January 2018; **Online:** 3 March 2018

Introduction

Nasal fractures are the most commonly observed fractures in the trauma setting. Prominence and fine structure of nose makes it vulnerable in front of the whole range of waste. Physical activity, falling from a height and physical conflict are the major mechanisms that lead to fracture of the nose. Deformity, swelling, bruising around the eyes and nose bleeding symptoms are suggestive of nasal fractures, while crepitus and mobility is a definite sign of nasal fractures.[1] A uniform classification of these fractures has not been established, but there have been some attempts to classify them. The nasal pyramid is a complex structure consisting of the 2 nasal bones and the 2 frontal processes of the maxillary bone. A nasal fracture can involve any part of the nasal pyramid. The lateral nasal walls (caudal part of the nasal bones and parts of the frontal processes) and the nasal dorsum (cranial part of the nasal bones), as well as the nasal septum, generally require the most attention when assessing a fracture of the nasal pyramid. If there are no further injuries, such as hematomas or expanded fractures of the nasal septum, within 7 days after trauma the patient undergoes reduction of the nasal fracture under local anesthesia or, in cases of noncompliance, under general anesthesia. Afterward, the nose is fixed with a plaster cast. Some authors recommend nasal packs to stabilize the bone fragments,

Department of Clinical Sciences, Faculty of Veterinary Medicine, Urmia Branch, Islamic Azad University, Urmia, Iran.
***Correspondence: Address all correspondence to Saimak Alizadeh (DVM, DVSc)**
E-mail: s_alizadeh01@yahoo.com

DOI: 10.22034/ivsa.2018.111734.1132

especially in the case of a depressed fracture. Failure to diagnose and treat fractures in the long term can lead to complications such as external deformity, nasal obstruction, nasal septum perforation and other complications such as chronic sinusitis. These symptoms are usually stable and may thrive in the long term.[2]

In addition to the clinical examination (crepitation, deviation from the midline, and dislocated fracture), the nasal bone fracture is often diagnosed by radiography. The radiographs usually comprise a lateral image of the nasal bone focused on the nasal dorsum and an occipito-mental radiograph from which the lateral nasal walls can be assessed. The need for radiography has been questioned by some authors, who find it an inappropriate means of assessing a nasal fracture. However, adequate imaging of a nasal fracture is often required because of legal consequences resulting from nasal fracture etiology. An alternative to radiography is ultrasonography, a common and easy method involving no additional radiation exposure. The value of ultrasonography as a diagnostic tool for the detection of "bone" fractures (eg, in congenital hip dislocation, fractures of the radial or clavicular bone, or fractures of the ribs or skull) has been proven in various studies. In addition, the nasal bone damage in dogs can lead to stunted growth of the middle part of the nose and facial bones.[3]

The correct diagnosis and appropriate treatment of nasal injuries reduces the risk of developing complications and also reduces the need for surgery. The definitive diagnosis of nasal fractures, done by the help of physical examination and nasal fracture must be confirmed by internal and external examinations. However, in some cases, physical examination may not diagnose fractures. A plain radiograph of the nose is commonly used in such cases but this method causes to high false-positive cases and as well as the inability to distinguish the old from, new types of fractures play little role in determining. Other diagnostic imaging such as computed tomography (CT-Scan) noted that in cases of severe trauma to the nose and damaged nearby structures in order to determine the extent of the fracture doubt was used.[4] Although nasal fractures are the most common facial fracture in both mature and young dogs, they often go unnoticed by Clinician. Patients with nasal fractures usually present with some combination of deformity, tenderness, hemorrhage, edema, ecchymosis, instability, and crepitation; however, these features may not be present or may be transient. To further complicate the matter, edema can mask underlying nasal deformity, crepitation, and instability; thus, many physicians and patients fail to pursue further diagnosis and appropriate treatment. If radiographic evaluation is warranted, it is best used when other facial fractures are suspected in combination with a nasal fracture, because isolated nasal fractures are treated on the basis of the physical examination alone. The fact that patients may have displaced nasal fractures and normal-appearing plain radiographic findings should be emphasized. Recently several articles on the use of ultrasonography in the diagnosis of pathologies of the nose and sinuses are mentioned. In a study evaluating the walls of the nose with ultrasonography was more useful than the radiography report. Instead bridge of the nose with radiographic assessment was superior to ultrasound.The nasal pyramid estimates by ultrasonography or radiography had no significant difference.[5] Another study is done on all cases of nasal bone fracture, diagnosed well by ultrasonography.[6]

Materials and Methods

In this retrospective study, 12 dogs (8 male and 4 female) with an average age of 2.7 years with a standard deviation of 1.07 (minimum age 9 months and maximum age of 15 years) and suspected with nasal fracture were investigated. Each animal was examined by an internal medicine specialist and the results were recorded in ENT registration forms and then they were referred to a radiologist to perform an ultrasound examination of their nose and the results were recorded in special forms. In this study the ultrasound device model (EUB-8500 XP, Hitachi Medical Corporation, Tokyo, Japan) and an 8-12 MHz linear probe (EUP-L54M, length: 53 mm) were used. Ultrasonography was performed in both Axial and Sagital oblique views and hypoechoic lines and loss of bone continuity were considered as a nasal fracture. Also, from the nose of each patient, two lateral and dorsoventral radiographs were obtained (Fig 1). Radiographs were encoded and then they were given to the radiologist. Data were analyzed using STATA 8 software and then descriptive statistics on the distribution of age, sex, cause and site of fracture, sensitivity, specificity, positive predictive value, negative predictive value, positive

likelihood ratio and negative likelihood ratio for each plain radiography and ultrasonography diagnostic methods were calculated. The accuracy of both methods was evaluated.

Figure 1. Lateral (A) and ventrodorsal (B) views of the skull. On the lateral view, fracture of the nasal bone is recognizable but on the ventrodorsal view due to superimposing bones in the head area, this fracture was not detected.

In this study, the sensitivity and specificity of each method were analyzed by anatomical site of the fracture. The most common sites of fractures were in the bridge of the nose (58.33%) and outer wall (41.66%). Out of 12 patients, in the statistical analysis performed in ultrasonography and the findings were as follow: Sensitivity: 96.4% (91.1-98.6%). Specificity: 93.3% (70.2-98.8%). Positive predictive value: 99% (95-100%). Negative predictive value: 78% (55-91%). Positive odds ratio: 46.14% (2.18-96.08%). Negative odds ratio : 0.04% (0.01-0.1%). Accuracy: 96%. In the radiographic method the findings were as follow: Sensitivity 81.1% (72.8-87.3%). Specificity: 86.7% (62.1-96.3%). Positive predictive value: 98% (92-99%). Negative predictive value 38% (24-55%). Positive odds ratio: 6.08% (1.67-22.16%). Negative odds ratio: 0.22% (0.14-0.34%). Accuracy: 82%.

Table1. The result of diagnostic value by both methods with confidence interval of 95%

Variable	Ultrasonography		Plain Radiography	
	Bridge of The Nose	Outer Wall	Bridge of the Nose	Outer Wall
Sensitivity	100% (93.4-100)	94.6% (82.3-98.5)	92.6% (82.4-97.1)	70.3% (54.2-82.5)
Specificity	50% (9.5-90.5)	100% (27.5-100)	50% (9.5-90.5)	0 (0-0)
Negative Predictive Value	100% (21-100)	33% (0.06-79)	20% (4-62)	0 (0-26)
Positive Predictive Value	98% (90-100)	100% (90-100)	98% (90-100)	96% (82-99)
Positive Odds Ratio	2%	*	1.85% (0.46-7.42)	0.7% (0.57-0.87)
Negative Odds Ratio	*	0.05% (0-0.05)	0.15% (0.03-0.79)	*
Accuracy	98%	95%	91%	68%

*These numbers were not statistically significant.

Discussion

Although the use of plain images is not suggested, the preferred examination includes the acquisition of Waters (occipitomental) and lateral nasal views if plain films are used. It should be noted that plain radiographs only serve to confuse the clinical picture in most cases. Plain radiographs do not allow identification of cartilaginous disruptions, fractures, shearing, and injury in general. Plain radiographs also do not provide sufficient information to assess injury severity and displacement, 2 important aspects essential to emergent and delayed management and surgical planning.[6] In the present study, the value of ultrasonographic diagnosis (96%) was higher than radiography (82%). In the present study, the reason for superiority of ultrasonography in nasal fracture diagnosis could be related to the dynamics of ultrasonography methods and the operator's ability to create images in different sections of the nasal structure. In this study, sensitivity of ultrasonography was 94.6% which was different from stody of others that reported an ultrasonographic sensitivity of 83% and was close to the results of the Jirava et al, 1988 studies that reported a sensitivity of ultrasonography of 100% and a radiographic sensitivity of 60-70%.[6,7] Considering that there are not many studies in relation to diagnostic value of ultrasonography in the diagnosis of nasal fracture and in almost all previous studies, the number of cases under study was less than 5,[8] so this study (with a sample size of 12 patients) was one of the first studies with large sample size in assessment of the value of ultrasonography in the diagnosis of nasal fracture. In another study, ultrasonography was better than radiography to assess the fracture of the outer walls of the nose. Instead, in evaluating the nasal bridge fracture, radiography was superior to ultrasonography. However, in the assessment of pyramid nose, neither of methods was superior to each other.[5] In another study that had been done to evaluate the puppy's nose fracture showed ultrasonographic images helping to detect fracture lines.[9]

According to the results obtained in this study, ultrasonography was effective in diagnosis of nasal fractures with have high sensitivity and specificity. The most specificity and sensitivity of ultrasonography was related to the fracture of the outer wall and bridge of the nose, respectively. The reason for this difference could be due to low sample size and that ultrasonography is an operator-dependent technique that affects its ability to diagnose fractures. In this study, puppies less than 3 months were excluded due to the possibility of the lack of distinction between frontonasal and vascular slots. Also, gender did not have significant effect on diagnosis of nasal fracture with ultrasonography or radiography. In the present study, physical contention and vehicle accident were the most common cause of nasal fractures, therefore, fracture pyramid (according to the mechanism of injury) showed the lowest abundance.

Conclusion

Since ultrasonography is an accessible, easy, non-invasive method with high sensitivity and specificity, it could be used to diagnose the nose fractures of dogs and we could replace it with plain radiography. Comprehensive and complete studies (in terms of sample size, technique, and devices used) in the future should be done in order to accurately investigate the role of ultrasonography in the diagnosis of nasal fracture. Future studies are needed to emphasize the determination of the diagnostic value of ultrasonography based on the location of the fracture.

Acknowledgments

This study was supported by Faculty of Veterinary Medicine, Urmia Branch, Islamic Azad University, Urmia, Iran.

Conflict of Interests

None

References

1. Belkin PV. Linear fracture of the cranial floor. *J Am Vet Med Assoc*, 1957; 31(7): 130:353.
2. Ettinger SJ and Feldman EC. Text book of veterinary internal medicine. *Pennsylvania, W. B. Saunders Co*, 2000; 5th edit: 39- 43.
3. Brinker W, Archibald J. Canine Surgery, Santa Barbara. *American Veterinary Publication*, 1974; 2th edit, 1035-1039.
4. Nathan MD, Keller AP, Lerner CJ and Davis JC. Diagnostic ultrasonography of the maxillofacial region. *Laryngoscope*, 1982; 92:767- 769.

5. Pollock S. Prosthesis for treatment of fracture of the canine maxilla. *J Am Vet Med Assoc*, 1985; 147:821-828.
6. Gage ED. Surgical correction of fractures involving the nasal and frontal sinuses in the dog. *Vet Med*, 1970; 65:1070-1095.
7. Jirava E, Krepelka V. Facial bone fractures in dogs. *Mod Vet Pract*, 1988; 49:93.
8. Stambaugh JE, Nunamaker DM. External skeletal fixation of comminuted maxillary fractures in dogs. *Vet Surg*, 1982; 2:72-95.
9. Hoffman P. Gari-Toussaint M, De Bievre C, Michiels JF, d'Horpock FA and Loubiere R. Rhino-orbito-cerebral mucormycosis caused by Rhizopusoryzae. A typical case in a cirrhotic patient. *Ann. Pathol*, 1993; 13:180-183.

نشریه جراحی دامپزشکی ایران
سال۲۰۱۷ ، جلد ۱۲ (شماره ۲)، شماره پیاپی ۲۷

چکیده

ارزیابی اولتراسونوگرافی در تشخیصی شکستگی بینی و مقایسه آن با رادیوگرافی ساده در سگ‌ها

سیامک علیزاده، علی حیات روحی

گروه علوم درمانگاهی، دانشکده دامپزشکی، دانشگاه آزاد اسلامی واحد ارومیه، ارومیه، ایران

هدف- یکی از علل مهم شکستگی بینی تروما می‌باشد که در معاینات بالینی و تصویربرداری تشخیصی می‌توان آن را تشخیص داد اما باید توجه داشت که در رادیوگرافی ممکن است شکستگی‌های کاذب در بینی دیده شوند. در این مطالعه به بررسی ارزش اولتراسونوگرافی در تشخیص شکستگی بینی در مقایسه با رادیوگرافی ساده پرداخته شده است.

طرح- مطالعه تجربی آینده‌نگر.

حیوانات- 12سگ بیمار مشکوک به شکستگی بینی.

روش کار- این سگ‌ها توسط اولتراسونوگرافی و رادیوگرافی در مقایسه با معاینه بالینی (استاندارد طلایی) ارزیابی شدند و نتایج حاصله به روش آماری مقایسه گردید. حساسیت، اختصاصیت، ارزش اخباری مثبت و منفی، نسبت شانس مثبت و منفی و دقت همراه با فاصله اطمینان ۹۵ درصد و در نهایت دقت هر دو تست محاسبه شد.

نتایج- در تشخیص شکستگی بینی به روش اولتراسونوگرافی، حساسیت ۹۶/۴ درصد، ویژگی۹۳/۳ درصد و دقت ۹۶ درصد بوده و در روش رادیوگرافی، حساسیت ۸۱/۱ درصد ، ویژگی ۸۶/۷ درصد و دقت ۸۲ درصد بود. بیشترین حساسیت تشخیصی در شکستگی‌های پل بینی در اولتراسونوگرافی ۱۰۰ درصد و در رادیوگرافی ۹۲/۶ درصد بوده و بیشترین ویژگی در تشخیص شکستگی دیواره خارجی بینی در اولتراسونوگرافی۱۰۰ درصد و در رادیوگرافی ۵۰ درصد بود.

نتیجه‌گیری و کاربرد بالینی- با توجه به نتایج این مطالعه می‌توان از اولتراسونوگرافی به عنوان یک روش غیر تهاجمی با حساسیت و اختصاصیت بالا در تشخیص شکستگی بینی سگ‌ها استفاده کرد.

کلمات کلیدی- شکستگی بینی، اولتراسونوگرافی، رادیوگرافی، سگ‌ها.