Journal of Feline Medicine and Surgery (2003) **5**, 227–235
doi:10.1016/S1098-612X(03)00023-8

jfms

Radiographic signs in cats with nasal disease

CR Lamb*, S Richbell, P Mantis

Department of Veterinary Clinical Sciences, The Royal Veterinary College, University of London, Hawkshead Lane, North Mymms, Hertfordshire AL9 7TA, UK

Radiographic signs in 64 cats that had radiography as part of the diagnostic work-up for suspected nasal disease were reviewed in a blinded fashion. Final diagnoses in these cats were rhinitis in 27, primary nasal neoplasia in 21 and non-nasal disease in 16. The signs with highest predictive value for nasal neoplasia were displacement of midline structures (73%), unilateral generalised soft tissue opacity (70%), unilateral generalised loss of turbinate detail (69%) and evidence of bone invasion (64%). The only radiographic finding that occurred more frequently in cats with rhinitis was a nasal cavity within normal limits, and the predictive value of this sign was only 38%. Radiographic signs in cats with nasal neoplasia are similar to those reported in dogs, whereas the radiographic signs in cats with rhinitis are variable and non-specific, and may be absent.

Date accepted: 28 February 2003

Introduction

Nasal diseases of cats may be divided predominantly into inflammatory conditions and neoplasms (Bright 1981). Feline rhinitis may be caused by various respiratory infections including calicivirus, feline herpesvirus-1, *Bordetella bronchiseptica*, *Chamydilophila felis* and *Cryptococcus neoformans* (Bradley 1984, Cape 1992, Malik et al 1992, Ford and Levy 1994, Van Pelt and Lappin 1994, Binns et al 1999, Mochizuki et al 2000). Rhinitis has also been associated with systemic conditions, such as feline immunodeficiency virus infection (Hopper et al 1989). Non-infectious feline rhinitides may occur as a result of eosinophilic or lymphoplasmacytic infiltration or foreign body (Bright 1981). Rhinitis (and any secondary sinusitis) may become chronic when inflammation is severe enough to cause structural changes in the nasal conchae that compromise their immunological function (Bright 1981, Bradley 1984, Levy and Ford 1994). Feline nasal neoplasms include a wide variety of cell types with malignant epithelial neoplasms and lymphoma predominating (Levy and Ford 1994). In a recent review of 123 feline nasal and sinus neoplasms, the most frequent diagnoses were lymphoma (28%), adenocarcinoma (15%) and squamous cell carcinoma (14%) (Mukaratirwa et al 2001). Inflammatory polyps, which often affect the nasopharynx and may obstruct the choanae, must be distinguished from neoplasms (Bradley 1984, Kapatkin et al 1990, Allen et al 1999).

Clinical signs in cats with nasal and nasopharyngeal diseases often include inappetance, nasal discharge, sneezing, stertor and mouth breathing. Epistaxis, facial deformity and exophthalmos are additional signs that are usually associated with relatively aggressive conditions (Levy and Ford 1994, Van Pelt and Lappin 1994). For cats with short-lived, serous nasal discharge suggestive of viral rhinitis, diagnosis may be based on clinical signs (Ford and Levy 1994). Viral isolation to identify carriers is usually reserved for management of recurrent outbreaks of rhinitis in multi-cat households or for epidemiological studies (Ford and Levy 1994, Mochizuki et al 2000). When clinical signs become chronic or more severe or nasal discharge becomes purulent, further diagnostic work-up is indicated (Cape 1992, Levy and Ford 1994).

Radiography is one of the principal diagnostic methods used in the investigation of cats (and dogs) with chronic nasal signs; however, there is relatively little published information about radiographic signs in cats with nasal disease compared to dogs. Coulson (1988) and Farrow (1994) have reviewed this subject. In 10 cats with chronic rhinosinusitis radiographed by Cape (1992), there was fluid/soft tissue opacity in the nasal cavity in

*Corresponding author. E-mail: clamb@rvc.ac.uk

seven, loss of turbinate detail in four, fluid/soft tissue was present in the ipsilateral frontal sinus in four, signs of destruction of the nasal or vomer bones were identified in two, and two cats had no radiographic signs. Cox et al (1991) briefly described the radiographic signs in 13 cats with nasal or sinus neoplasms. In 12/13 cats there was increased opacity affecting intranasal structures and in five there was evidence of bone destruction. Radiographic signs in a series of 29 cats, including 18 with nasal neoplasia and 11 with rhinitis were reported by O'Brien et al (1996). Unilateral loss of turbinates, bone erosion and tooth loss were associated with nasal neoplasia (O'Brien et al 1996). The prevalence of various other signs, including facial swelling and deviation or lysis of midline nasal structures, was similar in cats with neoplasia and chronic rhinitis (O'Brien et al 1996).

On the basis of these reports, there appears to be considerable overlap in the radiographic signs that may be observed in these conditions, hence radiography may be relatively less useful as a means of distinguishing rhinitis from nasal neoplasia in cats than it is in dogs. The aim of the present study was to describe the radiographic signs in a series of cats with nasal disease and to identify any signs that might be used to support a specific diagnosis.

Materials and methods

Medical records at the Queen Mother Hospital for Animals were searched for cats that had radiography of the skull and a nasal examination that included endoscopy. In each instance skull radiographs included a dorsoventral (intraoral) projection. Cases were collected by one of the investigators (SR) who did not participate in the radiographic evaluation. Medical records were reviewed with respect to age, sex, breed, and presence of clinical signs referable to conditions affecting the nasal cavity (nasal discharge, epistaxis, sneezing, facial deformity, exophthalmos, ocular discharge, stertor and dyspnoea). Cats were categorised into those with rhinitis, those with nasal neoplasia and those with a non-nasal condition. Diagnosis of rhinitis was based on presence of inflammatory cells (and absence of neoplastic cells) in nasal flushings or endoscopic biopsies, positive aerobic bacterial culture and/or retrieval of a nasal foreign body. In recognition of the fact that neoplasia may be missed by cytological or histological examination, some cats categorised as rhinitis in this study had multiple examinations involving endoscopy, all of which were negative for neoplasia. Also follow-up by telephone contact with the referring veterinary surgeons was used selectively to check that no cats categorised as rhinitis had a progressive course or additional test results that suggested underlying neoplasia. Diagnosis of nasal neoplasia was based on histological examination of nasal biopsy. All cats classified as having non-nasal conditions had no abnormalities identified by nasal endoscopy.

Radiographs were examined without knowledge of any clinical information by two radiologists (CRL, PM), who reached a consensus about the radiographic signs in each case and recorded their observations using a custom-designed form. The following signs were assessed: lesion location (unilateral, bilateral, rostral, middle or caudal part of nasal cavity or generalised), loss of turbinate detail (generalised, focal, multifocal), soft tissue/fluid opacities (generalised, focal, multifocal), lucent foci (generalised, focal, multifocal), presence of abnormal intranasal calcification, displacement of midline structures, evidence of invasion of bones surrounding the nasal cavity, evidence of facial deformity, lesions affecting the frontal sinuses (fluid/soft tissue content, aggressive or non-aggressive bone lesions) and dental lesions (absent teeth, loss of lamina dura, erosion of teeth).

On the basis of the radiographic signs, cats were also assigned a score based on the scheme of nasal radiographic patterns described by Myer (1998): "1, normal radiographic appearance of both nasal passages; 2, areas of increased soft tissue opacity superimposed over normal conchal pattern; 3, areas of increased soft tissue opacity superimposed over areas of conchal destruction; 4, areas of decreased opacity owing to conchal destruction without accompanying soft tissue opacity; 5, a mixed pattern with areas of conchal destruction and superimposed soft tissue opacity interspersed with areas of conchal destruction alone".

The median ages of cats with rhinitis and nasal neoplasia were compared using the Mann–Whitney U-test. Prevalence of clinical and radiographic signs in cats with nasal neoplasia and rhinitis were compared using Fisher's exact test.

Results

Sixty-four cats satisfied the criteria for inclusion, including 27 with rhinitis, 21 with primary nasal neoplasia and 16 cats without nasal disease

Table 1. Summary of diagnoses in 64 cats having nasal radiography

	n	Diagnosis
Rhinitis	27	Bacterial infection (14) Non-specific chronic rhinitis (6) Foreign body-associated (4) Polypoid rhinitis (2) Eosinophilic rhinitis (1)
Nasal neoplasia	21	Carcinoma (6) Lymphoma (6) Adenocarcinoma (5) Sarcoma (3) Granular cell tumour (1)
Non-nasal disease	16	Extra-nasal neoplasia (5) Dental disease (2) Laryngeal oedema (2) Nasopharyngeal stenosis (2) Stenotic external nares (1) Maxillary, nasal and mandibular fractures (1) Tracheitis (1) Aspiration pneumonia (1) Idiopathic orofacial pain syndrome of Burmese cats (1)

(Table 1). Rhinitis was associated with bacterial infection in 14 cats. Of these, there was evidence of a single bacterial infection in nine cats: *Pasteurella multocida* in six, *Staphylococcus intermedius* in one, *Pseudomonas aeruginosa* in one and *B bronchiseptica* in one. Five cats had mixed bacterial infection. The majority of nasal neoplasms were classified as carcinomata.

The age of cats ranged from 5 months to 17 years. A variety of breeds were represented, including 36 domestic shorthairs, five domestic longhairs, seven Siamese, five Burmese, four Persian, three Russian Blue, two Somali, one British shorthair and an Egyptian. Cats with nasal neoplasia were significantly older than cats with rhinitis (Table 2). The proportion of the cats with rhinitis that were pure-bred (44%) was significantly greater than the proportion of cats with nasal neoplasia that were pure-bred (19%). Similar clinical signs were recorded in cats with either rhinitis or nasal neoplasia (Table 3), although significantly more cats with rhinitis sneezed and significantly more cats with nasal neoplasia had epistaxis and/or facial deformity. The median duration of clinical signs prior to referral of cats was 3 months both for cats with rhinitis and those with nasal neoplasia.

Nasal structures were interpreted as abnormal radiographically in 19/27 (70%) cats with rhinitis, 21/21 (100%) cats with nasal neoplasia, and 3/16 (19%) cats with non-nasal disease. The radiographic signs recorded in the cats with rhinitis or nasal neoplasia are summarised in Table 4 and examples illustrated in Figs 1 and 2. The only radiographic finding that occurred more frequently in cats with rhinitis was a nasal cavity

Table 2. Signalment of 64 cats having nasal radiography

Diagnosis	*n*	Median (range) age (years)	M:F ratio	Proportion of affected cats that were pure-bred (%)
Rhinitis	27	6.5 (0.4–15)[a]	17:20	44[b]
Nasal neoplasia	21	11.9 (3.4–17)[a]	12:9	19[b]
Non-nasal disease	16	8.3 (1.8–13)	7:9	44

Key: M, male; F, female.
[a] Cats with rhinitis were significantly younger than cats with nasal neoplasia ($p=0.001$).
[b] The proportion of the cats with rhinitis that were pure-bred was significantly greater than the proportion of cats with nasal neoplasia that were pure-bred ($p=0.05$).

Table 3. Prevalence of selected clinical signs in 48 cats with rhinitis or nasal neoplasia

Sign	Rhinitis (*n*=27)	Nasal neoplasia (*n*=21)	*p*
Nasal discharge	22 (81%)	19 (90%)	NS
Epistaxis	2 (7%)	9 (43%)	0.005
Sneezing	20 (74%)	9 (43%)	0.02
Facial deformity	3 (11%)	8 (38%)	0.03
Exophthalmos	1 (4%)	2 (10%)	NS
Ocular discharge	6 (22%)	7 (33%)	NS
Stertor	0	1 (5%)	NS
Dyspnoea	6 (22%)	5 (24%)	NS

NS, difference not statistically significant.

Table 4. Summary of radiographic signs identified in 48 cats with rhinitis or nasal neoplasia

Sign	Rhinitis (n=27)	Nasal neoplasia (n=21)	p
Nasal structures within normal limits	8 (30%)	0	0.006
Position of lesion			
Unilateral	11 (41%)	14 (67%)	0.05
Bilateral	8 (30%)	7 (33%)	NS
Rostral	5 (19%)	3 (14%)	NS
Middle and/or caudal	3 (11%)	5 (24%)	NS
Generalised	11 (41%)	13 (62%)	NS
Soft tissue optics			
Focal	5 (19%)	4 (19%)	NS
Multifocal	3 (11%)	4 (19%)	NS
Generalised unilateral	5 (19%)	12 (57%)	0.006
Generalised bilateral	3 (11%)	2 (10%)	NS
Loss of turbinate detail			
Focal	3 (11%)	7 (33%)	NS
Multifocal	6 (22%)	3 (14%)	NS
Generalised unilateral	4 (15%)	9 (43%)	0.03
Generalised bilateral	2 (7%)	1 (5%)	NS
Lucent foci			
Focal	4 (15%)	1 (5%)	NS
Multifocal	5 (19%)	3 (14%)	NS
Calcification	0	1 (5%)	NS
Displacement of midline structures	3 (11%)	8 (38%)	0.03
Invasion of bones	3 (11%)	9 (43%)	0.01
Facial deformity	3 (11%)	4 (19%)	NS
Soft tissue/fluid in frontal sinus	7 (26%)	10 (48%)	NS
Absent teeth	16 (59%)	10 (48%)	NS
Nares obstruction	4 (15%)	6 (29%)	NS

NS, difference not statistically significant.

within normal limits (p=0.006). The predictive value of this sign was only 38%. Signs that occurred more frequently in cats with nasal neoplasia were displacement of midline structures, unilateral generalised soft tissue opacity, unilateral generalised loss of turbinate detail, displacement of midline structures and evidence of bone invasion (p<0.05). The signs with highest predictive value for nasal neoplasia were displacement of midline structures (73%), unilateral generalised soft tissue opacity (70%), unilateral generalised loss of turbinate detail (69%) and evidence of bone invasion (64%) (Table 5). Dental abnormalities were observed frequently in all groups of cats.

Of the various radiographic patterns of nasal disease described by Myer (1998), pattern 1 (normal radiographic appearance of both nasal passages) was associated with rhinitis and pattern 3 (areas of increased soft tissue opacity superimposed over areas of conchal destruction) was associated with nasal neoplasia (Table 6).

In each of the three cats with non-nasal disease in which the radiographs were interpreted as showing signs of intranasal disease, lesions affecting adjacent structures were superimposed on the nasal cavity in one or more of the radiographs evaluated. These included a cat with cutaneous lymphoma causing a swelling superimposed on the frontal sinuses, a cat with multiple fractures affecting the maxillae, nasal bones and mandible, and a cat with a large irregular exostosis centred on the alveolus of a canine tooth, which was superimposed on the adjacent nasal cavity, but which was considered to be an incidental, non-nasal condition on the basis of clinical findings.

Discussion

The cats in this study were referred for investigation of nasal signs of median duration of 3 months. We identified no examples of either cryptococcosis or aspergillosis, which are uncommon causes of rhinitis in cats in the UK (Goodall et al 1984, Coulson 1988, Gaskell 1994). The predominance of lymphoma and carcinomata in cats in this series with nasal neoplasia is compatible

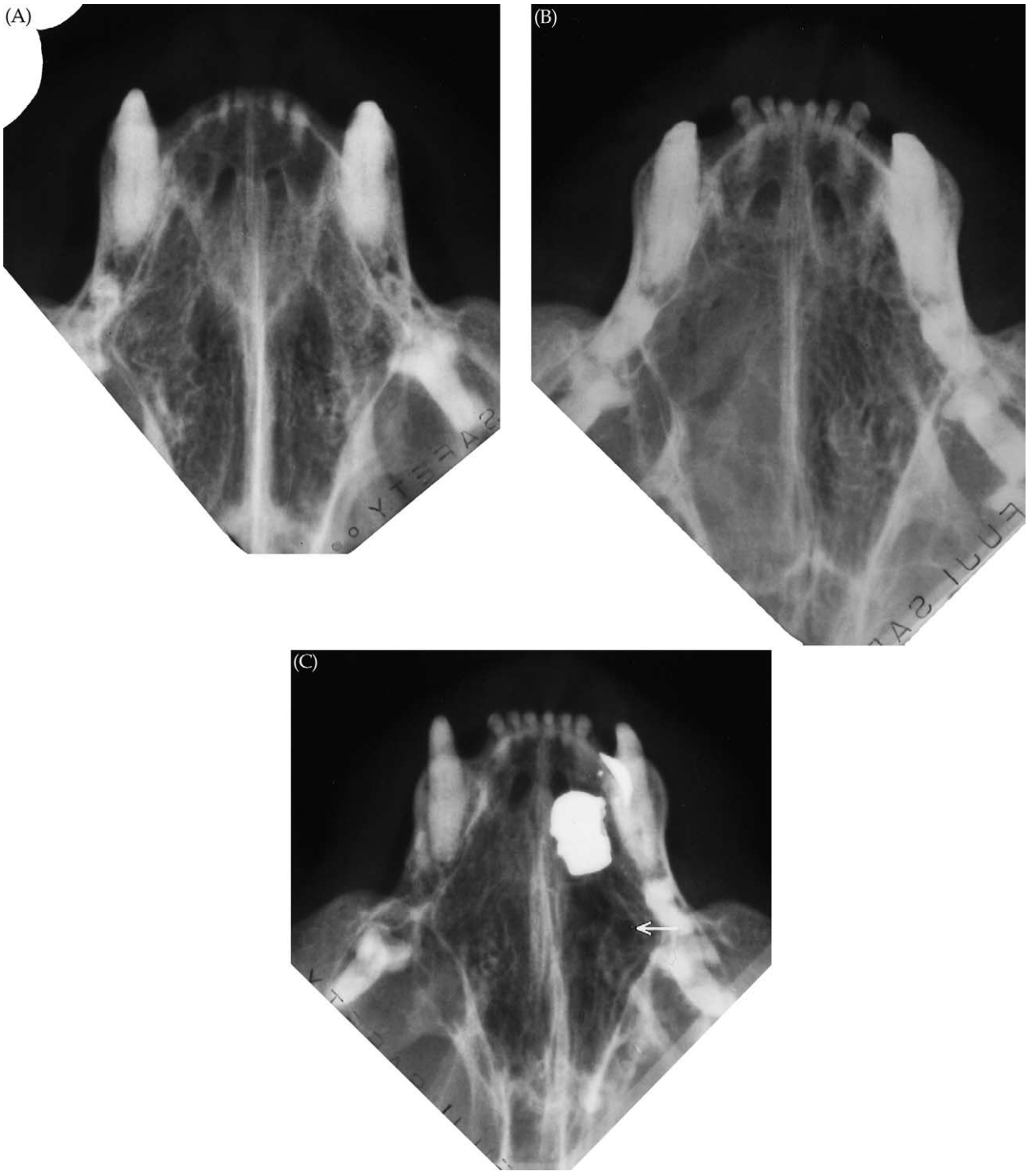

Fig 1. Examples of radiographic signs in cats with chronic rhinitis. (A) Dorsoventral (intraoral) radiograph of a cat with rhinitis associated with a mixed bacterial infection, in which the intranasal structures were interpreted as within normal limits; (B) dorsoventral (intraoral) radiograph of a cat with chronic necrotising rhinitis, in which there is a generalised increase in opacity with loss of turbinate detail affecting the right nasal cavity; (C) dorsoventral (intraoral) radiograph of a cat with an airgun pellet lodged in the rostral part of the left nasal cavity. There are lucent foci (arrow) compatible with localised turbinate destruction just caudal to the foreign body.

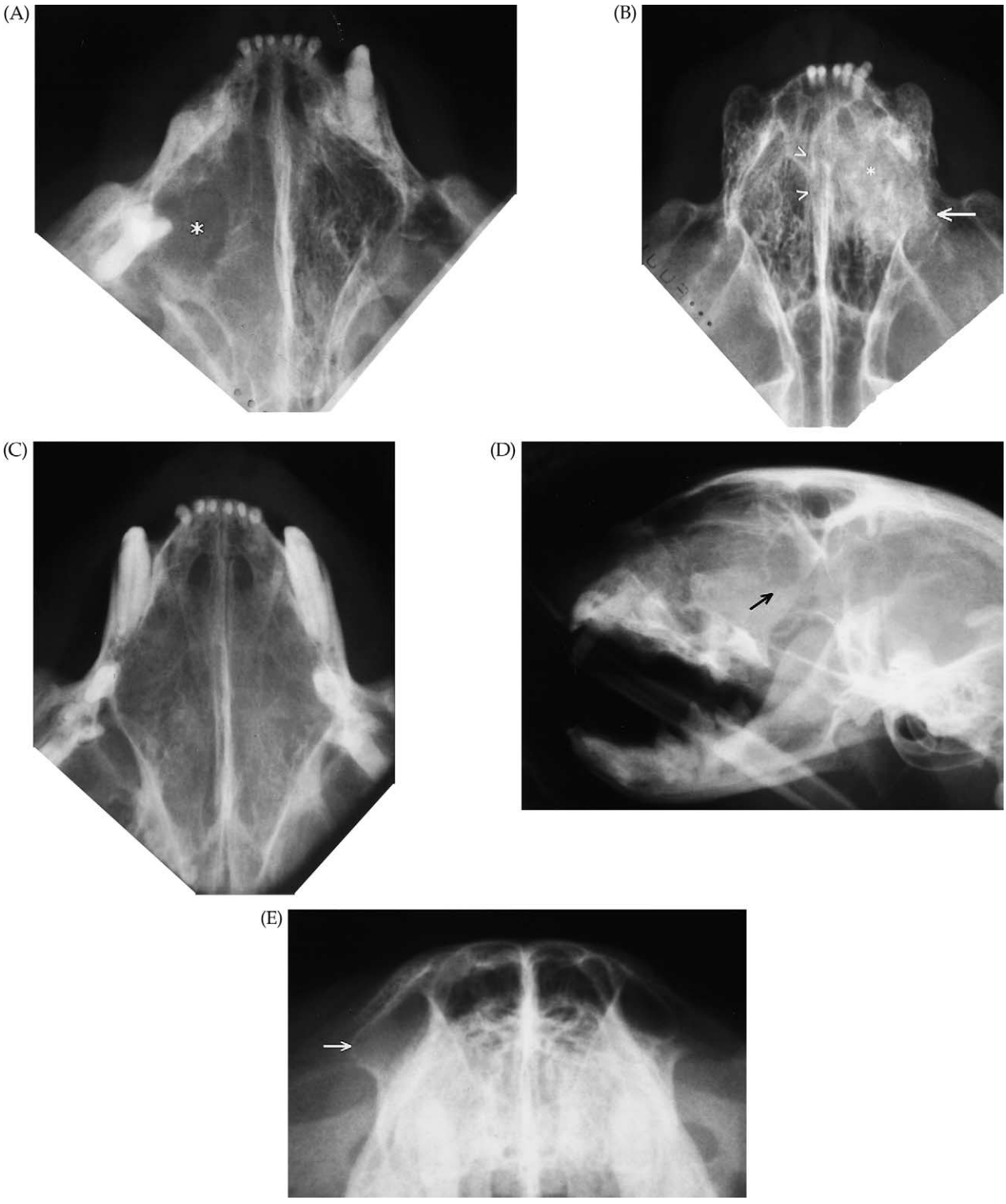

Fig 2. Examples of radiographic signs in cats with nasal neoplasia. (A) Dorsoventral (intraoral) radiograph of a cat with a granular cell tumour originating in the right nasal cavity. There is a relatively uniform increased opacity with loss of turbinate detail affecting the right nasal cavity and focal lucent area (*) as a result of bone destruction; (B) dorsoventral (intraoral) radiograph of a cat with a poorly differentiated sarcoma of the left nasal cavity. There is a partially calcified mass (*) that extends across the midline (arrowheads) and laterally (arrow). Multiple teeth are absent as a result of pre-existing dental disease; (C) dorsoventral (intraoral) radiograph of a cat with a carcinoma, in which there is a bilateral, relatively uniform increase in opacity and loss of turbinate detail; (D) lateral radiograph of a cat with nasal carcinoma, in which there is evidence of destruction of the cribriform plate (arrow) as a result of tumour invasion; (E) rostrocaudal radiograph in which there is increased opacity affecting the right frontal sinus (arrow). This occurred more frequently in cats with nasal neoplasia, but is also observed in cats with rhinosinusitis (see text).

Table 5. Predictive values of radiographic signs in 64 cats having nasal radiography

	Predictive value[a]		
	Individual signs	Signs in combination	
Signs of rhinitis			
Nasal structures within normal limits	8/21 (38%)	–	
Signs of nasal neoplasia			
Displacement of midline structures	8/11 (73%)		
Unilateral generalised soft tissue opacity	12/17 (70%)	5/6 (83%)	
Unilateral generalised loss of turbinate detail	9/13 (69%)		6/7 (86%)
Invasion of bones	9/14 (64%)		
Unilateral nasal lesion(s)	14/25 (56%)		

[a] Predictive value of sign for disease $X = \frac{\text{number of cats with this sign and disease } X}{\text{total number of cats with this sign}}$.

Table 6. Classification of radiographic signs in 48 cats with rhinitis or nasal neoplasia

Pattern	Number of cats with radiographic signs		
	Rhinitis (n=27)	Nasal neoplasia (n=21)	p
1	9[a] (33%)	0	0.002
2	3 (11%)	2 (10%)	NS
3	6 (22%)	16 (76%)	0.0002
4	2 (7%)	0	NS
5	7 (26%)	3 (14%)	NS

Based on scheme described by Myer (1998).

[a] One cat was classified as pattern 1 (normal radiographic appearance of both nasal passages) despite presence of a metallic foreign body lodged just caudal to the external nares.

with previous reports. We identified no examples of squamous cell carcinoma, which is considered relatively prevalent but usually affects the nasal planum rather than intranasal structures (Levy and Ford 1994, Mukaratirwa et al 2001). One cat in this study had a nasal granular cell tumour, which has been reported rarely in the cat (Patnaik 1993).

Positioning for radiography and the radiographic anatomy of the feline skull have been described in some detail by Farrow (1994). All the cats in this study had a dorsoventral (intraoral) radiograph and nearly all had lateral and ventrodorsal or dorsoventral projections; however, there were variations in the number of radiographs obtained, which reflects attempts to optimise the radiographic examination according to the cats' clinical signs. For example, some cats also had a rostrocaudal radiograph to examine the frontal sinuses and some had oblique radiographs to examine the dental arcades. The projections that are probably most useful in dogs with nasal signs are the dorsoventral (intraoral) view of the nasal cavity and the rostrocaudal view of the frontal sinuses. These projections are useful because there is minimal superimposition of the nasal cavity and frontal sinuses by other structures, and each provides an opportunity to compare left and right, which aids recognition of unilateral or asymmetrical lesions. It is difficult to obtain a satisfactory view of the frontal sinuses in rostrocaudal radiographs in breeds of cat with a short nose and relatively small frontal sinuses, such as Persians. The ventral 20° rostral-dorsocaudal oblique is a useful alternative projection for examining the frontal sinuses. Lateral radiographs are frequently unhelpful for assessing animals with unilateral lesions confined to the nasal cavity because superimposition of the normal half of the skull on the abnormal half tends to mask abnormalities; however, the lateral view aids identification of lesions extending through the nasal or frontal bones or destroying the cribriform plate (Fig 2D), which is a feature of nasal neoplasms that invade the brain (Smith et al 1989). Lateral radiographs are also useful for identifying lesions affecting the nasopharynx, such as polyps (Kapatkin et al 1990).

The difficulties of examining the feline nasal cavity radiographically are emphasised in this study by the finding that the radiographs of a few cats with non-nasal disease were interpreted erroneously as showing signs of intranasal

disease. This probably occurred because lesions affecting adjacent structures were superimposed on the nasal cavity in one or more of the radiographs evaluated. Computed X-ray tomography also appears to be a useful method for examining the nasal cavity and nasopharynx in cats (Losonsky et al 1997, Allen et al 1999) largely because it eliminates the problem of superimposition.

As has been reported previously (Cox et al 1991, Cape 1992, O'Brien et al 1996), we found considerable overlap in the radiographic signs in cats with rhinitis or nasal neoplasia. Of the various signs we assessed, displacement of midline structures, unilateral generalised soft tissue opacity, unilateral generalised loss of turbinate detail, evidence of bone invasion and unilateral nasal lesion(s) were significantly associated with nasal neoplasia, but the predictive value of these signs was relatively modest, in the range 56–73%. When examining radiographs of cats (or dogs) with nasal signs, finding a combination of signs increases the predictive value. For example, of the seven cats in this study that had a unilateral nasal lesion associated with generalised loss of turbinate detail, generalised increased soft tissue opacity and evidence of invasion of bones, six (86%) had nasal neoplasia. As described previously with respect to nasal disease in dogs (Russo et al 2000), differentiation of rhinitis and nasal neoplasia should ideally be based on finding combinations of signs that together have a high predictive value.

The radiographic signs we identified in cats with nasal neoplasia are similar to those reported in dogs (Sullivan et al 1987, Russo et al 2000). One noteworthy difference is the lower proportion of cats with nasal neoplasia that had recognisable fluid/soft tissue opacity in the frontal sinus (48%) compared to dogs (70%). This and the higher proportion of cats with rhinitis that also had fluid/soft tissue opacity in the ipsilateral frontal sinus (26%), combine to reduce the predictive value of this sign (Fig 2E), making it less useful as a means of distinguishing these conditions than it is in dogs. Frontal sinusitis is a common sequel to chronic rhinitis in cats (Bradley 1984, Cape 1992).

Radiographic signs in cats with rhinitis are more variable and less specific than those for nasal neoplasia, and in 30% affected cats in this study the radiographs appeared to be normal. The presence of lucent foci, which is an important sign of destructive rhinitis in dogs (Sullivan et al 1986, Russo et al 2000), was recognised in relatively few cats in this study. Lucent foci may be observed in cats with either foreign body (Bright 1981) or aspergillosis (Goodall et al 1984); however, these are uncommon diagnoses. The inclusion of four nasal foreign bodies in this study could be considered unrepresentative of their incidence in cats. Three of these were metallic airgun pellets, which greatly facilitated their detection. The remaining nasal foreign body, a piece of grass awn, was not visible radiographically.

References

Allen HS, Broussard J, Noone K (1999) Nasopharyngeal diseases in cats: a retrospective study of 53 cases (1991–1998). *Journal of the American Animal Hospital Association* **35**, 457–461.

Binns SH, Dawson S, Speakman AJ, Cuevas LE, Gaskell CJ, Hart CA, Morgan KL, Gaskell RM (1999) Prevalence and risk factors for feline *Bordetella bronchiseptica* infection. *Veterinary Record* **144**, 575–580.

Bradley RL (1984) Selected oral, pharyngeal, and upper respiratory conditions in the cat. *Veterinary Clinics of North America. Small Animal Practice* **14**, 1173–1184.

Bright RM (1981) Nasal foreign bodies, tumors, and rhinitis/sinusitis. In: Bojrab MJ (ed), *Pathophysiology in Small Animal Surgery*. Philadelphia: Lea and Febiger, pp. 335–349.

Cape L (1992) Feline idiopathic chronic rhinosinusitis: a retrospective study of 30 cases. *Journal of the American Animal Hospital Association* **28**, 149–155.

Coulson A (1988) Radiology as an aid to diagnosis of nasal disorders in the cat. In: Grunsell GSG, Raw ME, Hill FWG (eds), *The Veterinary Annual* (28th edn). London: Scientechnica, pp. 150–158.

Cox NR, Brawner WR, Powers RD, Wright JC (1991) Tumors of the nose and paranasal sinuses in cats: 32 cases with comparison to a national data base (1977 through 1987). *Journal of the American Animal Hospital Association* **27**, 339–347.

Farrow CS (1994) The head. In: Farrow CS, Green R, Shively M (eds), *Radiology of the Cat*. St. Louis: Mosby, pp. 1–29.

Ford RB, Levy JK (1994) Infectious diseases of the respiratory tract. In: Sherding RG (ed), *The Cat. Diseases and Clinical Management* (2nd edn). New York: Churchill Livingstone, pp. 489–500.

Gaskell CJ (1994) The respiratory system. In: Chandler EA, Gaskell CJ, Gaskell RM (eds), *Feline Medicine and Therapeutics* (2nd edn). Oxford: Blackwell, pp. 253.

Goodall SA, Lane JG, Warnocke DW (1984) The diagnosis and treatment of a case of nasal aspergillosis in cat. *Journal of Small Animal Practice* **25**, 627–633.

Hopper CD, Sparkes AH, Gruffydd-Jones TJ, Crispin SM, Muir P, Harbour DA, Stokes CR (1989) Clinical and laboratory findings in cats infected with feline immunodeficiency virus. *Veterinary Record* **125**, 341–346.

Kapatkin AS, Mathiesen DT, Noone KE, Church EM, Scavelli TE, Patnaik AK (1990) Results of surgery and long-term follow-up in 31 cats with nasopharyngeal polyps. *Journal of the American Animal Hospital Association* **26**, 387–392.

Levy JK, Ford RB (1994) Diseases of the upper respiratory tract. In: Sherding RG (ed), *The Cat. Diseases and Clinical Management* (2nd edn). New York: Churchill Livingston, pp. 947–978.

Losonsky JM, Abbott LC, Kuriashkin IV (1997) Computed tomography of the normal feline nasal cavity and paranasal sinuses. *Veterinary Radiology and Ultrasound* **38**, 251–258.

Malik R, Wigney DI, Muir DB, Gregory DJ, Love DN (1992) Cryptococcosis in cats: clinical and mycological assessment of 29 cases and evaluation of treatment using orally administered fluconazole. *Journal of Medical and Veterinary Mycology* **30**, 133–144.

Mochizuki M, Kawakami K, Hashimoto M, Ishida T (2000) Recent epidemiological status of feline upper respiratory infections in Japan. *Journal of Veterinary Medical Science* **62**, 801–803.

Mukaratirwa S, van der Linde-Sipman JS, Gruys E (2001) Feline nasal and paranasal sinus tumours: clinicopathological study, histomorphological description and diagnostic immunohistochemistry of 123 cases. *Journal of Feline Medicine and Surgery* **3**, 235–245.

Myer W (1998) Nasal cavity and paranasal sinuses. In: Thrall DE (ed), *Textbook of Veterinary Diagnostic Imaging* (3rd edn). Philadelphia: WB Saunders, pp. 59–65.

O'Brien RT, Evans SM, Wortman JA, Hendrick MJ (1996) Radiographic findings in cats with intranasal neoplasia or chronic rhinitis: 29 cases (1982–1988). *Journal of the American Veterinary Medical Association* **208**, 385–389.

Patnaik AK (1993) Histologic and immunohistochemical studies of granular cell tumors in seven dogs, three cats, one horse, and one bird. *Veterinary Pathology* **30**, 176–185.

Russo M, Lamb CR, Jakovljevic S (2000) Distinguishing canine nasal neoplasia and rhinitis by radiography. *Veterinary Radiology and Ultrasound* **41**, 118–124.

Smith MO, Turrel JM, Bailey CS, Cain GR (1989) Neurologic abnormalities as the predominant signs of neoplasia of the nasal cavity in dogs and cats: seven cases (1973–1986). *Journal of the American Veterinary Medical Association* **195**, 242–245.

Sullivan M, Lee R, Jakovljevic S, Sharp NJH (1986) The radiological features of aspergillosis of the nasal cavity and frontal sinuses in the dog. *Journal of Small Animal Practice* **27**, 167–180.

Sullivan M, Lee R, Skae CA (1987) The radiological features of sixty cases of intra-nasal neoplasia in the dog. *Journal of Small Animal Practice* **28**, 575–586.

Van Pelt DR, Lappin MR (1994) Pathogenesis and treatment of feline rhinitis. *Veterinary Clinics of North America. Small Animal Practice* **24**, 807–823.