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Original Article

A Retrospective Study on Histopathological and Cytological Evaluations to Guide Surgical and Chemotherapeutic Strategies in Canine Tumours

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ABSTRACT

Introduction: Canine tumours cause significant morbidity and mortality, yet diagnostic methods in resource-limited settings remain inadequate. The present study assessed the pathological range and compared fine-needle aspiration cytology (FNAC) with histopathology to guide surgical and chemotherapeutic strategies in Veterinary Teaching Hospitals in Ibadan, Nigeria.
Materials and methods: This retrospective study on suspected canine tumour cases (n=73) was collected from 2018 to 2025 across three veterinary centers in Ibadan, Nigeria. Clinical records were reviewed and data on demographics, tumour types, and diagnostic methods were systematically tabulated. Chi-square goodness-of-fit tests were employed to evaluate differences in age groups (middle-aged to geriatric), sex, diagnostic procedures such as FNAC and tissue biopsy, treatment modalities including surgical excision versus chemotherapy, and survival outcomes. Performance metrics of aspiration biopsy, comprising sensitivity, specificity, and predictive values, were calculated in comparison with histopathological findings. Furthermore, McNemar's test was used to evaluate discordance between fine-needle cytology and biopsy results.
Results: Age distribution was uneven, with the highest prevalence in 5-8-year-olds (30.1%). Male number was dominant (60.3%), but this difference was not statistically significant. Boerboels (37.0%) and German shepherds (30.1%) were more present than other breeds, suggesting possible breeder bias or increased breed-related tumor development. Tumor types included transmissible venereal tumours (21.9%), mammary tumours (13.7%), and lymphomas (9.6%). Use of diagnostic tools was different, with fine-needle cytology accounting for 45.2% and biopsy for 47.9% of procedures. Fine needle cytology had a sensitivity of 85% and specificity of 90%, with a positive predictive value of 92% and a negative predictive value of 81%, showing a nonsignificant difference with histopathology. Treatment approaches were different, with 61.6% receiving chemotherapy alone, 13.7% receiving both chemotherapy and surgery, 5.5% undergoing surgery only, and 19.2% receiving no treatment. The overall survival rate was 38.4%.
Conclusions: The FNAC offered valuable initial information, whereas histopathology provides the definitive diagnosis. Implementing a stepwise diagnostic approach can facilitate more efficient utilization of limited resources, improve accuracy in prognostication, and ultimately enhance survival rates of dogs in Nigeria.

1. Introduction

Canine tumours represent a major health challenge in veterinary medicine, affecting nearly one in four dogs during their lifetimes[1,2]. Canine tumours also represent another primary health concern in veterinary medicine, with their occurrence shaped by multiple biological and environmental factors. Age is a key determinant, as the incidence of tumours rises markedly from six years of age and peaks around eleven years, while specific tumours, such

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as ocular neoplasms, may appear in both very young and older dogs[1,3]. Additionally, sex differences are pronounced, with female dogs exhibiting higher overall tumor rates, particularly mammary tumours, which predominate between six and eighteen years of age[1,4,5]. Breed predispositions highlight genetic influences, as breeds such as Golden Retrievers, Boxers, and Terriers show increased susceptibility to distinct tumor types. These patterns underscored the complex, multifactorial nature of canine oncology, where genetic, physiological, and environmental interactions collectively shape tumor risk[1,3,4,6,]. A review of veterinary hospital records in Abuja, Nigeria, revealed that 87.5% of neoplasms diagnosed were in dogs, while a multicenter survey spanning from 2000 to 2017 indicated that 44% of all neoplastic cases in Nigerian veterinary teaching hospitals occurred in the canine population. Among tumor types, papillomas (38.1%) and mast cell tumours (28.6%) were the most frequently encountered, with additional analyses identifying oral tumours as a distinct category, where melanoma emerged as the predominant malignant lesion and acanthomatous ameloblastoma as the most common benign form. Demographic patterns further indicated a male predisposition, with 57.1% of cases occurring in males compared to 42.9% in females, while malignant tumours were more frequently diagnosed in older dogs, with a mean age of approximately 11.6 years[5]. Olaifa et al.[4] reported in 2025 on a high prevalence of transmissible venereal tumour (TVT) cases, particularly in female Boerboels owned by breeders, who presented to the University of Ibadan Veterinary Teaching Hospital, Theriogenology Unit, in Ibadan, Nigeria. However, the true incidence of canine tumours may be underestimated due to underreporting and restricted access to advanced veterinary care[4,5]. These tumours, which include lymphomas, genital tumours, osteosarcomas, and mammary tumours, not only compromise the quality of life for affected animals, but also share biological behaviors similar to human cancers[3,6]. Accurate diagnosis of canine neoplasms is therefore critical, as it directly informs treatment decisions and prognostic outcomes. Histopathological examinations and cytological evaluations, which assess individual cells from minimally invasive samples, are essential tools in distinguishing tumor types, grading their aggressiveness, and predicting clinical behavior. However, despite technological advancements, challenges such as the high cost of treatment, underfunded teaching hospitals, and a lack of a central national register persist in obtaining consistent and accurate diagnoses, due to the variability in tumour presentations and limitations in current diagnostic protocols in Nigeria[4,5]. The preferred method for tumour diagnosis in Nigeria is histopathology of tissue biopsies[7-10]. However, field veterinarians frequently rely on Giemsa-wright-stained fine-needle aspiration cytology (FNAC) and clinical observations, often choosing to excise the growth before conducting characterization mass[4,5]. The present study aimed to clarify the role of FNAC, histopathology, and hematology in guiding surgical and chemotherapeutic strategies for canine tumours by retrospectively correlating diagnostic findings with treatment outcomes to generate evidence-based recommendations that enhance clinical decision-making and improve the rate of survival in dogs.

2. Materials and Methods

2.1. Ethical approval

Ethical standards were rigorously maintained; formal permissions were obtained from the veterinary institutions to access case records, and all data were anonymized to protect patient and owner confidentiality, with access restricted to authorized personnel only.

2.2. Study design

The present study employed a retrospective design, utilizing an expanded collection of clinical records to evaluate the impact of histopathological and cytological evaluations on the management of canine tumours. By analyzing 73 cases documented from 2018 to January 2025, the study identified trends in diagnostic practices, correlated treatment outcomes, and assessed the prognostic value of specific histopathological features. Strict inclusion criteria ensured that only cases with confirmed histopathological diagnoses supported by cytological evaluations and complete clinical records were analyzed, while cases with incomplete documentation were excluded.

2.3. Data collection

Data were collected from several veterinary institutions in Ibadan, Nigeria, including the Veterinary Teaching Hospital at the University of Ibadan, Veterinary Hospital Mokola, and Shalekeen Pet Home. These centers served a diverse canine population, comprising different breeds, ages ranging from 6 months to 14 years, and sexes, thereby offering a comprehensive sample that accurately reflected the region's heterogeneous demographic and environmental characteristics. The data collection involved systematic reviews of cytology forms, histopathological case files, and clinical records, ensuring the extraction of key information on tumour types such as TVT, oral papillomas, diagnostic methods, including FNAC, histopathology, haematology, and treatment strategies such as chemotherapy, surgical excisions, or mixed. Additionally, a survey administered to pet owners supplemented clinical data by capturing knowledge on treatment decisions and challenges in accessing veterinary care.

2.4. Diagnostic and treatment

The present study evaluated diagnostic techniques by examining histopathological and cytological methods used to diagnose canine tumours. Histopathological analysis, regarded as the gold method, was conducted on tissue samples obtained through surgical biopsies or fine-needle aspirations (FNA). The procedures involved fixation, sectioning, and hematoxylin and eosin (H&E) staining to evaluate cellular structure and distinguish between benign and malignant lesions[11,12]. Complementary cytological techniques, such as FNAC and smear preparations, provided rapid preliminary diagnoses and were critical for real-time evaluation during surgical procedures[13-15]. In terms of treatment, the study documented surgical interventions ranging from excisional biopsies to radical resections and chemotherapeutic protocols, including the administration of agents such as vincristine, with detailed records maintained on dosages, schedules, and patient responses[2,6,16,17].

2.5. Data analysis

Data were organized utilizing software tools such as Microsoft Excel and Google Sheets, thereby facilitating the efficient collation and visualization of parameters, including tumour types, treatment plans, and patient information outcomes[18,19]. Statistical analyses, including descriptive statistics, chi-square tests, and Kaplan-Meier survival analyses, were employed to evaluate tumour frequency, breed predisposition, and treatment efficacy[19]. Pearson's chi-square goodness-of-fit test was used to determine whether observed frequencies for age, sex, diagnostic method, treatment approach, and survival outcome deviated from a uniform distribution. Age was categorized into five groups, sex as male/female, diagnostic sampling such as complete blood count (CBC), FNAC, excisional biopsy, management as chemotherapy, chemotherapy plus surgery, surgery alone, or none, and survival outcome as survived or died. Expected counts were generated by dividing the total number of cases (n = 73) by the number of categories in each variable, with statistical significance set at $p < 0.05$.

3. Results

The present study assessed 73 canine tumour cases and identified significant patterns concerning age, breed, diagnostic method, treatment, and outcome (Table 1). The prevalence of tumours was highest among middle-aged to senior dogs (5-8 years, n = 22, 30.1%), followed by dogs aged 3-5 years (n = 17, 23.3%) and those older than 9 years (n = 16, 21.9%; Figure 1). The present results revealed that the 5-8 year age group was significantly higher than the expected hypothesis ($p < 0.05$). Male dogs comprised 60.3% of the cases, compared to 39.7% females, indicating a male predominance in the sample; however, the sex difference was not statistically significant ($p > 0.05$). Breed distribution (Figure 2) was dominated by Boerboels (n = 27, 37.0%) and German Shepherds (n = 22, 30.1%), with Rottweilers (n = 12, 16.4%), Dobermans (2.7%), and small breeds, such as the Lhasa Apso (1.4%), also represented. Diagnostic approaches differed significantly across cases ($p < 0.05$). Tissue biopsy (47.9%) and FNAC (45.2%) were the primary methods, with biopsies providing definitive histopathological grading and FNAs offering a quick preliminary assessment. Meanwhile, blood tests (5.5%) and excisional biopsies (1.4%) were used infrequently. For treatment methods, the most common approach was chemotherapy (n = 6, 61.6%), followed by a combination of chemotherapy and surgery (n = 10, 13.7%), surgery alone (n = 4, 5.5%), and no treatment in 19.2% (n = 14) of cases. The overall survival rate was observed in 38.4% of the cases (n = 28), which was significantly lower than the benchmark of 50% ($p < 0.05$); meanwhile, 61.6% of the cases resulted in death (n = 45). This diagnostic distribution emphasized the importance of histopathology for accurate tumor characterization, even in resource-limited clinical settings. The present analysis revealed distinct patterns in treatment approaches and tumour characteristics. Regarding treatment methods, chemotherapy emerged as the most frequently employed intervention, followed by a combination of chemotherapy and surgical intervention, while surgical treatment alone was the least used method for tumour resolution.

Table 1. Categorical distributions among 73 canine tumor cases from three veterinary centers in Ibadan, Nigeria, from 2018 to 2025

Category	Observed cases (Number)	Expected cases (Number)	χ^2	df	p-value
Age distribution	<1 y: 3, 1-3 y: 15, 3-5 y: 17, 5-8 y: 22, ≥9 y: 16	14.6 each	13.51	4	0.009
Sex distribution	44 M, 29 F	36.5 each	3.08	1	0.079
Diagnostic method	CBC 4, FNA 33, Excision 1, Biopsy 35	18.25 each	54.63	3	< 0.001
Treatment method	Chemo 45, Chemo + Surg 10, Surg 4, None 14	18.25 each	54.95	3	< 0.001
Survival outcome	Survived 28, Died 45	36.5 each	3.96	1	0.046

Observed N: Number of cases observed in each category (raw counts), Expected N: Number of cases expected under the null hypothesis, χ^2: Pearson's chi-square test statistic for goodness-of-fit, df: Degrees of freedom for the chi-square test, y: Year, M: Male, F: Female, CBC: Complete blood count, FNA: Fine-needle aspiration, Chemo: Chemotherapy, Surg: Surgical treatment/excision, N: Sample size.

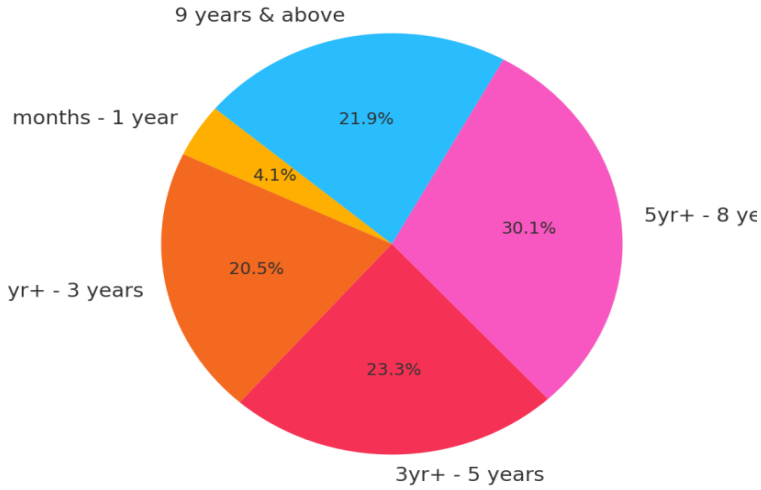

Figure 1. Age distribution of canine patients. Light and dark orange: Young dogs less than three years, Red: young dogs aged 3-5 years, Pink: Middle-aged dogs between 5-8 years, Blue: Dogs older than nine years.

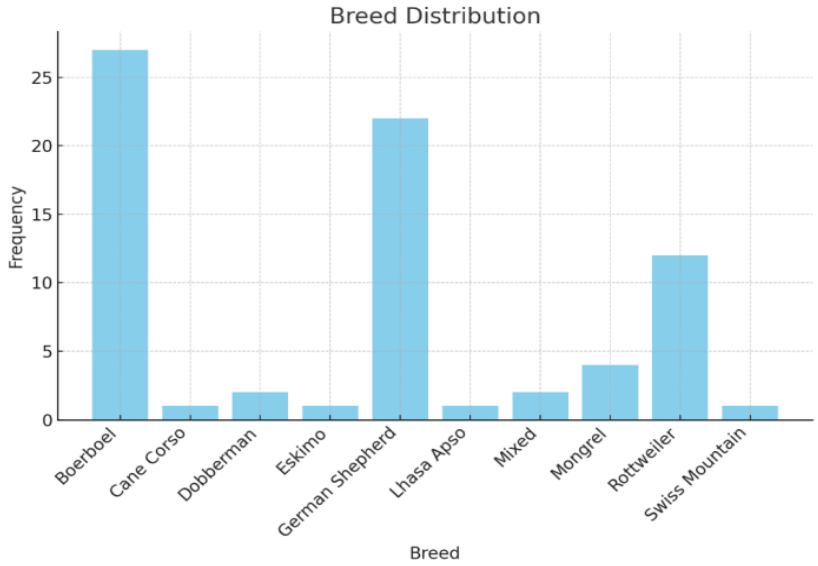

Figure 2. Breed distribution of dogs diagnosed with neoplastic conditions

Survival outcomes demonstrated that 38.4% of canine patients survived following their treatment regimen, while the majority (61.6%) did not survive. The tumour type distribution demonstrated considerable variation, with TVT representing the most prevalent diagnosis at 21.9% of cases (n = 16), likely due to breeding practices[14]. Mammary gland tumours were the most frequent, with unspecified mammary tumours (n = 6, 8.2%) and mammary carcinomas (n = 4, 5.5%) together accounting for 13.7% of all diagnoses, a significantly higher proportion compared to several different tumour categories ($p < 0.05$). Hepatic tumours (n = 4, 5.5%) and cutaneous tumours (n = 3), including papillomas (4.1%) and squamous cell carcinomas (4.1%), were moderately represented. Less common neoplasms included lymphomas (1.4-2.7%), sarcomas (2.7%), and site-specific tumours (intestinal, oral, testicular, ovarian), each contributing 1.4% of cases, none of which differed significantly from expected counts ($p > 0.05$). Unclassified tumours comprised 4.1% of cases (n = 3; Figure 3).

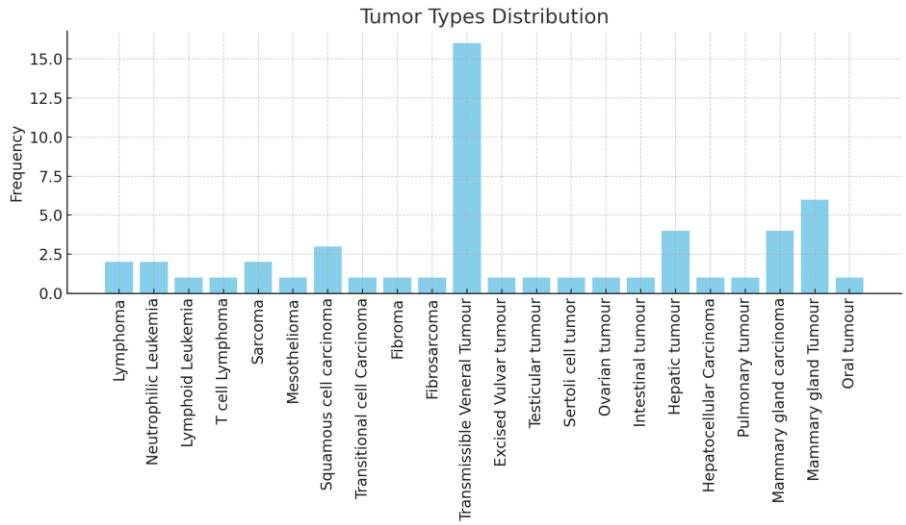

Figure 3. Tumour distribution from 73 diagnosed canine tumor cases presented to the Veterinary Teaching Hospital, University of Ibadan, Nigeria, from 2018 to 2025. Transmissible venereal tumor was the most common, followed by mammary, hepatic, and cutaneous tumours, while others were less frequent. Pearson's chi-square test confirmed that transmissible venereal tumor occurred significantly more often than expected ($p < 0.05$).

The survey of 100 dog owners in Ibadan, Nigeria, revealed important patterns in canine tumour cases. German Shepherds (30%), Boerboels (25%), and Rottweilers (20%) accounted for the majority of cases, reflecting their popularity in the Southwestern region of Nigeria. Most diagnoses occurred in dogs aged 1 to 10 years, with the highest proportion (40%) in the 1 to 5 year age group. Male dogs (60%) outnumbered female dogs (40%), and only 35% of the dogs had undergone spaying or neutering procedures. Owners typically noticed tumours within 1 to 3 months of appearance (50% of cases), with visible swelling or lumps being the most common initial sign (50%). Malignant tumours (45%) slightly outnumbered benign cases (40%), while 15% of owners were uncertain about their pet's tumour type. The skin and subcutaneous tissue (50%) and mammary glands (20%) were the most

frequent tumour locations.

Diagnostic approaches included biopsies (50%), FNA (25%), over-imaging modalities (10%), or solely clinical examination (10%). Veterinarians most often recommended surgery (50%) or chemotherapy (30%) as treatment options. While 60% of dogs underwent surgery, survival outcomes varied; 50% survived after surgery, with only 35% living beyond one year. Complications occurred in 40% of surgical cases, ranging from minor issues (30%) to major complications (5%). Long-term outcomes indicated 40% of dogs fully recovered, but 30% experienced tumour recurrence and 20% developed metastatic spread. Despite these challenges, 70% of owners reported being satisfied or very satisfied with their pet's treatment outcomes, indicating generally positive perceptions of veterinary care received. A tiered, pathology-driven diagnostic algorithm for Nigerian clinics used FNAC as the first-line test for high-prevalence tumours such as TVT, lymphomas, and mammary lesions to provide rapid cytological grading and inform immediate management; biopsy with histopathology was reserved as a reflex test for FNAC-equivocal samples, suspected high-grade malignancies, or when architectural detail was required for surgical planning; routine surveillance employs periodic FNAC in surgically managed patients to detect recurrence while minimizing repeat invasive biopsies.

4. Discussion

In the present retrospective analysis of 73 canine tumours from local veterinary clinics in Nigeria, the pathological spectrum was characterized, and the relative effectiveness of FNAC compared to histopathology was evaluated in a resource-limited environment. Middle-aged dogs (5-8 years) constituted the largest cohort, followed by those 3 to 5 years and over 9 years, underscoring the escalating risk of neoplasia with age[20]. Male dogs predominated, a pattern that could result from hormonal factors and owner preferences for certain breeds selection[14,21,22]. Large breeds, including Boerboels, German Shepherds, and Rottweilers, accounted for the majority of cases, suggesting breed predispositions and local population structure[1]. Transmissible venereal tumor was identified as the most common diagnosis, following the mixed mammary tumours and mammary carcinomas. This pattern of TVT aligns with regional reports of Olaifa et al.[4], where TVT was frequently encountered predominates[4,22]. Less frequent tumours included hepatic lesions, cutaneous papillomas, and squamous cell carcinomas, which correlated with those reported by Bendas et al.[22-24]. Lymphomas and sarcomas each comprised 2.7% of cases, consistent with the findings of Götze et al.[3], while 4.1% (n = 3) remained unclassified[3,24].

The FNAC provided rapid, minimally invasive preliminary diagnoses, particularly valuable for TVT and lymphoid lesions, while histopathology delivered definitive grading and architectural context[23,25,26]. Complete blood counts and excisional biopsies played minor roles in the diagnosis. These proportions highlighted FNAC as a feasible first-line tool, with biopsy reserved for equivocal or high-grade tumours[11]. Chemotherapy was the primary treatment, often initiated based on FNAC findings, while combined chemotherapy–surgery was used in 13.7% and surgery alone in 5.5% of cases. Notably, 19.2% of cases received no treatment, reflecting financial or logistical constraints. Overall survival was 38.4% of the cases, with 61.6% dying, which highlighted the aggressive nature of many canine tumours and the urgent need for early diagnosis[24,27].

The present study, conducted at a single Nigerian referral center, might overemphasize advanced or complicated cases, which could limit how well the results apply to everyday practice. Additionally, financial and logistical challenges affecting owner decisions may introduce bias in treatment choices and outcomes.

Prospective studies are needed to accurately determine FNAC sensitivity and specificity across the full spectrum of canine tumour types. Incorporating adjunct techniques, such as immunocytochemistry and digital image analysis[3,11], could enhance cytological resolution. The development of telecytology and telepathology networks, incorporating Artificial Intelligence (AI) and the use of liquid biopsy, would facilitate real-time remote consultations and reduce diagnostic turnaround times. Additionally, investigating breed-specific genetic risk factors, particularly in overrepresented large breeds, may enable targeted surveillance and early screening protocols[1].

5. Conclusion

The FNAC and histopathology play vital roles in the diagnosis of canine tumours, with FNAC facilitating rapid preliminary grading and histopathology delivering definitive analysis and assessment. Implementing a pathology-driven algorithm that emphasizes FNAC and reserves biopsy for uncertain or high-grade cases can improve decision-making and optimize resource utilization in Nigeria clinics. Future studies should validate FNAC performance across tumour types and explore adjunct tools such as immunocytochemistry, liquid biopsy, and AI-enabled telepathology, alongside genetic studies to support targeted surveillance in high-risk breeds.

Declarations

Ethical consideration

The authors have identified ethical issues, including plagiarism, duplicate submission, and data falsification.

Competing interests

The authors declared no conflict of interests.

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of the Faculty of Veterinary Medicine, University of Ibadan, Nigeria.

Authors' contributions

Abayomi Kayode Olaifa conceptualized the study and developed the methodology and laboratory procedures, including FNAC and histopathology. Olanrewaju Samuel Olaifa performed cytological evaluations, the formal data analysis, interpreted statistical results, and drafted the initial manuscript text. Olugbenga Alaka and Omotayo Ayomikun Alaka conducted detailed histopathological analysis, captured and curated imaging data, contributed to data interpretation, and oversaw sample collection. Olatunde Babatunde Akanbi provided overall project supervision and facilitated access to institutional resources. Richard Edem Antia optimized laboratory protocols, contributed to methodological refinement, and critically reviewed manuscript drafts. Adedayo Ariyibi provided expert statistical consultation, validated analytical approaches, and substantially revised the manuscript for important intellectual content. All authors reviewed and approved the final edition of the manuscript.

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Availability of data and materials

The raw data is available upon request, and the supplementary information can be supplied by the corresponding author.

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