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Prospects for the Societal Integration of Veterinary Nuclear Medicine and Targeted Radionuclide Therapy (TRT)

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Background Research

In Japan, the high social status of companion animals has driven the adoption of advanced diagnostic imaging. Despite a 2009 legal revision permitting veterinary nuclear medicine, strict regulations - which limit practice to dogs, cats, and horses - and restricted radionuclide availability (^{99m}Tc, ^{18}F, ^{11}C, ^{13}N and ^{15}O) mean that only two facilities, Kitasato University and the Japan Racing Association, currently offer these services.

While modalities such as FDG-PET have become indispensable and standard practice in human medicine for cancer staging and management, the translation of these critical nuclear medicine techniques to veterinary practice in Japan remains severely underdeveloped. As malignant tumors continue to be the leading cause of mortality in companion animals, there is a profound expectation for advanced diagnostics and minimally invasive, highly effective treatments like Targeted Radionuclide Therapy (TRT).

The primary bottleneck hindering the widespread adoption of veterinary nuclear medicine in Japan is the absence of an optimized legal framework. Directly applying existing human medical regulations to veterinary settings presents unique challenges. These include the necessary involvement of animal caregivers (owners) during the process, potential risks of environmental contamination via animal excreta, and the lack of veterinary-specific radiation safety guidelines. Consequently, systemic regulatory barriers prevent the societal integration of these life-saving technologies.

Recognizing this critical disparity, this research is motivated by the urgent need to understand global standards and alternative regulatory models. To identify pathways for overcoming domestic challenges, we initiated a comprehensive investigation into the current landscape of veterinary nuclear medicine overseas. Specifically, our focus is on Germany, representing a nation with advanced Western clinical and regulatory models, and Southeast Asian countries, which represent rapidly developing regions in this specialized field. By conducting this comparative analysis, we aim to bridge the regulatory gaps and establish a foundational roadmap for the societal integration of world-class veterinary nuclear medicine and TRT in Japan.

Research Objectives

The ultimate objective of this study is to establish a foundational theoretical framework for rational legal reforms, paving the way for the societal integration of veterinary nuclear medicine in Japan, including currently unapproved Targeted Radionuclide Therapy (TRT). At present, radiation protection in domestic veterinary practice is forced to rely on diverted human medical standards. There is a critical lack of veterinary-specific guidelines that account for the unique biokinetics of animals, the requisite presence of caregivers (owners), and radioactive excreta management. This legal and regulatory void constitutes the primary barrier to the introduction of advanced radiological treatments.

In alignment with the Fukushima Institute for Research, Education and Innovation's (F-REI) initiative to establish a new radionuclide production hub, this research endeavors to spearhead the application of cutting-edge technologies in veterinary medicine. By doing so, we aim to broaden oncological treatment options for animals and establish a domestic veterinary radiation practice system that fully complies with global standards.

To achieve these comprehensive goals, this study will investigate the following four specific areas:

1. *Diagnostic Impact: Evaluating the clinical contributions of existing veterinary nuclear medicine in Japan, with a specific focus on the outcomes of FDG-PET examinations conducted at Kitasato University.*
2. *Awareness and Demand: Conducting comprehensive surveys to analyze the current awareness and potential demand for veterinary nuclear medicine among both pet owners and veterinary professionals.*
3. *International Benchmarking: Investigating the facility infrastructure and operational realities in advanced nations to extract the essential requirements for domestic implementation.*
4. *Comparative Medicine Perspectives: Identifying and formulating new research challenges within veterinary nuclear medicine grounded in the principles of comparative medicine.*

1. Japanese Veterinary ^{18}FDG-PET

Supplemental Data: The List of Diagnostic Results



The nuclear medicine imaging system utilized at Kitsato university Veterinary Teaching Hospital is a single-photon emission computed tomography (SPECT) scanner.

In conventional SPECT devices, simultaneous Positron Emission Tomography (PET) imaging is impossible. However, this SPECT system, equipped with opposing 180-degree gamma cameras, allows simultaneous detection. With this SPECT device, one can perform imaging for general scintigraphy, SPECT, and PET.

Scan the QR code for details on the FDG-PET scan procedure

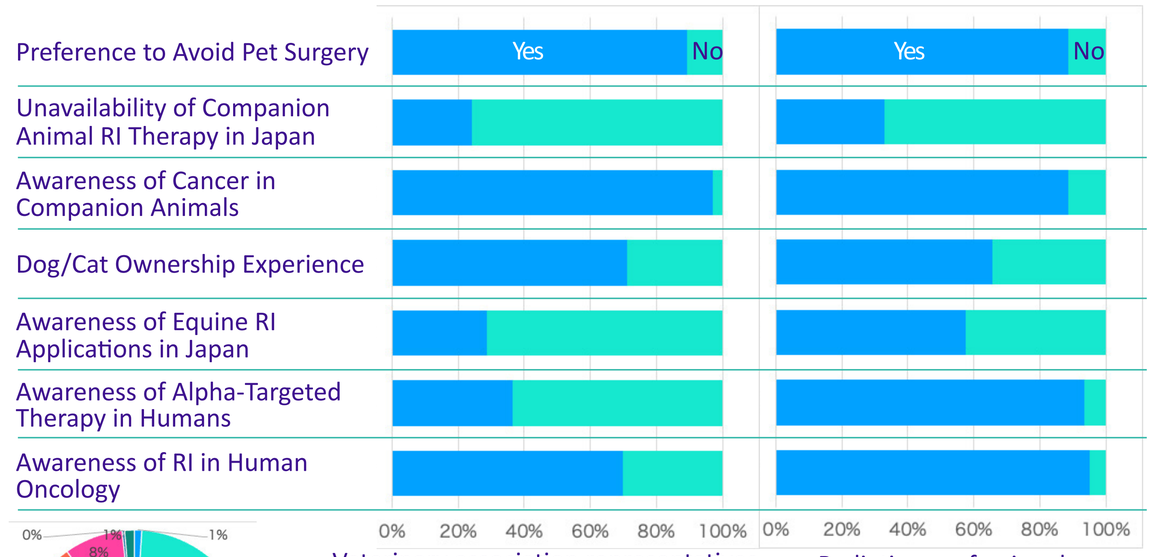
Clinical Impact of FDG-PET on Diagnostic Profiles (N=61)	
Recurrence and metastasis, undetectable by otherexaminations, were confirmed with FDG-PET.	7/61 (11%)
The tumor was observed in the image inspection, but it was determined to be normal in the FDG-PET scan.	11/61 (18%)
Although other imaging examinations suggested a tumor, it was not visualized in the FDG-PET scan.	6/61 (10%)
FDG-PET depicted a specific inflammatory response that was not a tumor.	4/61 (7%)

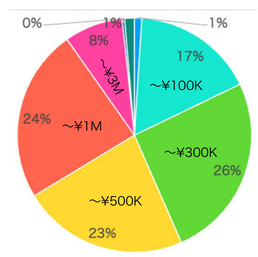
Predictive Value	True Tumor	False Tumor
FDG-PET Positive	40	4
FDG-PET Negative	6	11
Total 61 cases	87% Sensitivity (CT&MRI 85%)	73% Specificity (CT&MRI 27%)

If diagnosing cancer remission, the indispensable procedure even in veterinary medicine was the FDG-PET.

Trends in the Number of Veterinary Nuclear Medicine Examinations at Kitasato University and Across Japan (Please scan the QR code)

2. Veterinary Nuclear Medicine in Japan: Awareness & Demand



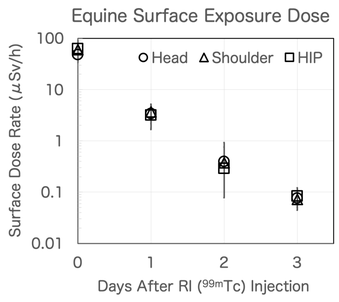


The left pie chart depicts survey data on the acceptable financial limits for veterinary care. Notably, the results indicate that many veterinary professionals remain unaware that veterinary nuclear medicine is available in Japan, or lack fundamental familiarity with nuclear medicine principles.

Konsortium für veterinärmedizinische Nuklearmedizin
Wir bitten Sie freundlich um Ihre Mithilfe beim Ausfüllen des Fragebogens zur veterinärmedizinischen Nuklearmedizin TRT.

3. Global Benchmarking: Essential Requirements for Japan





This summarizes equine radiation safety protocols in Germany. Despite a mandated 72-hour post-administration isolation, horses maintain physical conditioning via controlled access to lunging arenas. Empirical dosimetry confirms that as long as the maximum 20 cm surface dose rate from ^{99m}Tc remains below 100 μSv/h, the 50-year committed effective dose to the public is kept strictly below the 1 mSv limit, even with continuous contact. Applying similar legally flexible controlled-area policies in Japan could catalyze the economic viability of the racehorse industry.



In Thailand, the absence of detailed regulations for radioactive iodine-131 (^{131}I) therapy has historically delayed its implementation due to public safety concerns. However, establishing dedicated ^{131}I facilities is legally permissible, indicating that regulatory gaps—rather than technological deficits—constitute the primary barrier to clinical integration.

At Kasetsart University, the baseline ambient dose rate is 0.1 mSv/h. Treated animals are cleared for discharge when the dose rate at 50 cm falls below 0.3 mSv/h. Unlike Japan, mandatory isolation wards are not required, enabling animals to undergo concurrent diagnostic procedures, such as CT scans, alongside nuclear medicine examinations.



In Malaysia, medical physicists and specialists from National Cancer Institute actively facilitate veterinary technology transfer, seamlessly adapting human internal dosimetry protocols. This medical-veterinary collaboration embodies "One Health" in practical application. At Universiti Putra Malaysia (UPM), a globally diverse student body and an English-based curriculum drive continuous modernization. While currently maintaining more modest equipment than Kasetsart University, UPM's clinical operations are exceptionally logical and advanced, even attracting requests from Australia. With an impending MRI installation, faculty discussions strongly indicate a rapid, comprehensive integration of advanced radiotherapy and nuclear medicine.

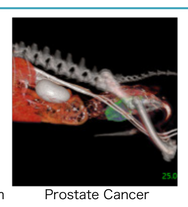
4. Future Directions: Insights from Comparative Medicine

Based on international observations, gray and white horses emerge as prime candidates for TRT due to high incidences of melanoma and lymphoma. Conversely, applying TRT to food-producing animals remains practically unfeasible, hindered by strict food safety regulations demanding zero residual radioactivity and severe biosecurity restrictions. In stark contrast, companion animals offer profound potential for TRT. Their oncological profiles closely mirror human cancers, presenting strong clinical rationales for treating specific malignancies such as osteosarcoma and pancreatic cancer.

In particular, Astatine-211 (^{211}At), characterized by its short half-life (7.2 hour), represents a highly promising radionuclide that should be actively pursued for veterinary applications.

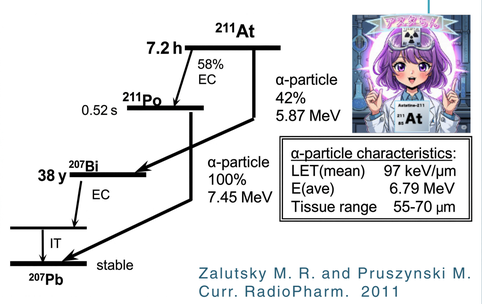
Examples of Promising ^{211}At-Labeled Ligands for Veterinary Applications	
Disease	Applicable Radioactive Ligands
Malignant Melanoma	[^{211}At]NpG-GGn4c
Hyperthyroidism, Thyroid cancer	Na^{211}At
Prostate Cancer	^{211}At-PSMA
Pheochromocytoma	^{211}At-MABG
Osteosarcoma	^{211}At-AAMT


Ectopic Hyperthyroidism


Prostate Cancer


Pheochromocytoma


Melanoma



Zalutsky M. R. and Pruszynski M. Curr. RadioPharm. 2011

Conclusion

There is a profound and unmet demand among pet owners for the integration of advanced nuclear medicine into Japan's veterinary healthcare system. Particularly regarding Targeted Radionuclide Therapy (TRT), companion animals exhibit a high prevalence of naturally occurring tumors that serve as ideal clinical targets. If TRT can be pioneered in veterinary oncology, the resulting empirical data could be reciprocally translated to human healthcare, significantly accelerating novel radiopharmaceutical development. To realize this potential, Japan must urgently reform its regulatory framework, guided by successful global policies.

Furthermore, through active collaborations with universities worldwide, we aim to lead the further advancement of veterinary nuclear medicine across Asia.

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