Evaluating the efficacy of ^{99m}Tc- ECD radiodrug in cat's brain scintigraphy

Gholamreza Assadnassab[1], Shahram Dabiri Oskoei[2], Babak Mahmoudian[2], Mohammadreza Valilou[3], Shahin Zavaregi maleki[4]

1- Department of Clinical Science, Faculty of Veterinary Medicine, Tabriz Branch, Islamic Azad University, Tabriz, Iran
2- Department of Nuclear Medicine, Tabriz University of Medical sciences and Health Services, Tabriz, Iran.
3- Department of Pathology Science, Faculty of Veterinary Medicine, Shabestar Branch, Islamic Azad University, Shabestar , Iran
4- General Pharmacologist & Toxinology student PhD, Ubc chemistry collage of Toronto, Canada
Corresponding author: Gholamreza Assadnassab
*Corresponding author's email: assadnassabgh@iaut.ac.ir, assadnassabgh@gmail.com
Tel: 0989144121145

Abstract: The aim of this study was to evaluate the efficacy of ^{99m}Tc-ECD radiodrug in cat's brain scintigraphy . In present study, 12 adult healthy cats were selected and brain scintigraphy was done with radiopharmaceutical ^{99m}Tc-ECD in these cats. In this method, the administration of radioisotopes to the body and accumulation of these substances in the target tissues, specific imaging is obtained, which is based on distribution of gamma radiations exposed from these radioisotopes and recording of them. For scintigraphy, animals were taken under anesthetic condition and ^{99m}TC-ECD was injected from femoral vein as bolus at the 2 mCi. 20 minutes after intravenous injection of radioidrug scintigraphic operations were done. The ROIs can be drawn in all scans and radioactive counts were easily measured. Our results show that the radiopharmaceutical ^{99m}Tc-ECD has excellent evaluate the efficacy in cat's brain scintigraphy.

[Gholamreza Assadnassab, Shahram Dabiri Oskoei, Babak Mahmoudian, Mohammadreza Valilou, Shahin Zavaregi maleki. **Evaluating the efficacy of ^{99m}Tc- ECD radiodrug in cat's brain scintigraphy.** *Life Sci J* 2013;10(5s):103-106] (ISSN:1097-8135). http://www.lifesciencesite.com. 18

Keywords: Brain, Cat, Scintigraphy, ^{99m}Tc-ECD

1. Introduction

Radiopharmacology is the study and preparation of radiopharmaceuticals, which are radioactive pharmaceuticals. Radiopharmaceuticals are used in the field of nuclear medicine as tracers in the diagnosis and treatment of many diseases. Many radiopharmaceuticals use technetium-99m (^{99m} Tc) which has many useful properties as a gamma-emitting tracer nuclide (Awuawanne, 1995; Sutton, 1998). Brain scintigraphy, also known as brain scanning or brain imaging, refers to several examinations using radioisotopes that evaluate the function or anatomy of it. This technique is one of many imaging methods used to evaluate the brain. Because blood flow in the brain is tightly coupled to local brain metabolism and energy use, ^{99m}Tc is used to assess brain metabolism regionally, in an attempt to diagnose (Henkink et al., 1996; Dewey, 2008; Sutton, 1998). Different types of brain scans are used to examine different aspects and functioning of it, however, all of these procedures involve the injection of a radiotracer or radioisotope, or imaging substance that emits a tiny amount of radioactivity, into the body. Because the radiotracer accumulates differently in different kinds of tissue, it can help physicians determine diagnosis. Brain scintigraphy can also be used to evaluate ill status (Awuawanne, 1995; Henkink et al., 1996). After injection, the radiotracer eventually accumulates in the brain, where it gives off energy in the form of gamma rays. This energy is detected by a device called a gamma camera. The camera works with a computer to measure the amount of radiotracer absorbed by the body and to produce special scans offering details on both the structure and function of organs and tissues. The gamma camera, which is encased in metal, is capable of detecting radiation and taking pictures from different angles. A gamma camera does not emit any radiation (Henkink et al., 1996; Mettler, 1998). Nuclear medicine imaging exams focus on depicting physiologic processes within the body, such as rates of metabolism or levels of various other chemical activities, and plus showing anatomy and structure. Areas of greater intensity, called "hot spots", indicate where large amounts of the radiotracer have accumulated and where there is a high level of chemical or metabolic activity. Less intense areas, or "cold spots", indicate a smaller concentration of radiotracer and less chemical activity (Mettler, 1998; sutton, 1998). There are a few conventional radiopharmaceuticals for brain scintigraphy such as ^{99m}Technecium labelled diethylenetriaminepentaacetic acid (^{99m}Tc DTPA),

glucoheptonate (^{99m}Tc GH), or ^{99m}Technecium-pertechnetate (^{99m}Tc O^{4-}), ^{99m}Technecium hexamethyl propyleneamine oxime (^{99m}Tc HM-PAO) and ethyl cysteinate dimer (^{99m}Tc ECD)which are available for veterinary purposes as well (Daniel et al., 1992; Dykes et al., 1994; Balogh et al., 1999). Different radiolabelled pharmaceuticals are used, and the most commonly used agent is ^{99m}Tc-ECD (ethyl cysteinate dimer). Technetium-99m is a metastable nuclear isomer of technetium-99, symbolized as ^{99m}Tc and making it the most commonly used medical radioisotope.Technetium-99m when used as a radioactive tracer can be detected in the body by medical equipment (gamma cameras). It is well suited to the role because it emits readily detectable 140 kev gamma rays (these are about the same wavelength as emitted by conventional X-ray diagnostic equipment), and its half-life for gamma emission is 6.0058 hours (meaning 93.7% of it decays to ^{99}Tc in 24 hours). The short physical half-life of the isotope and its biological half-life of 1 day (in terms of human activity and metabolism) allows for scanning procedures which collect data rapidly, but keep total patient radiation exposure low. The same characteristics make the isotope suitable only for diagnostic but never therapeutic use (Balogh et al., 1999; Zolle, 2007). Technetium-99m was discovered in 1938 as a product of cyclotron bombardment of molybdenum. This procedure produced molybdenum-99, a radionuclide with a longer half-life (2.75 days), which decays to 99mTc. At present, molybdenum-99 (Mo-99) is used commercially as the easily transportable source of medically used 99m Tc. In turn, this Mo-99 is usually created commercially by fission of highly enriched Uranium in aging research and material testing nuclear reactors in several countries (Zolle, 2007). ECD is a kind of medicine called a chelating agent. Chelating agents work by binding and holding on to radioactive materials or poisons that get into the body. Once bound to a radioactive material or poison, the chelating agent is then passed from the body in the urine. Chelating agents help decrease the amount of time it takes to get a poison out of the body (Henkink et al., 1996; Mettler, 1998). Considering that brain is one of the main body organs which outbreaks with physiological functions (Ettinger, 2009; Dewey, 2008). So brain scintigraphic imaging is very important in nuclear medicine. In addition to the structural composition of the brain, the physiological functions the reveals by this technique (Dewey, 2008; Mettler, 1998). Nuclear medicine has been rapid progress in recent decades. In this method, the administration of radioisotopes to the body and accumulation of these substances in the tissues, specific imaging is obtained, which is based on distribution of gamma radiations exposed from these radioisotopes and recording of them. Gamma radiations, which is made by isotopes, are hit to detector made of large crystal of iodine and potassium as activator and are converted directly to light energy or photons (Mettler, 1998; Sutton, 1998).

2. Materials and methods

In this survey we used of double-detector Phillips ADAC apparatuses model Vertex. This machine was calibrated and special software was designed. 12 adult apparently healthy cats were selected. Blood examinations such as Cr, Bun, CBC were done normality. For scintigraphy, animals were taken under anesthetic condition and were recumbency on back. Later, 99mTC-ECD was injected from femoral vein as bolus at the 2 mCi. 20 minutes after intravenous injection of a small amount of radioisotope scan makes. Scintillating counter is placed on head area and both before and after injection of the radiopharmaceutical agent, the study will be done (Barthez, 2006; Mettler, 1998).

Mie was the name of counter machine. During the action, one person was careful to constantly move that the animal does not carry out operations to disrupt the scan. Scintillator was set up of the scan's table. 20 minutes after rapid injection of radioactive agent by a syringe, imaging started. Secondary activity of the syringe after injection was measured by the counter device. Animals were anesthetized by Ketamine at the 10mg/kg as main drug and Acepromazine 0.05mg/kg as pre-anesthetic drug (Adams, 2001; Hall et al., 1998). For better to count on the animal's injection site was considered as a lead guard. 20 minutes after injection, dynamic scanning was started and total scan duration was 30 minutes. Then counting amount of different brain area can be done automatically by computer utility in regions outline interest (ROI) mode.

3. Results

Figure 1 shows accumulation of ^{99m}TC-ECD in feline upper half of the body. Figure Uptake of ^{99m}TC-ECD in brain of another feline in teral scans. Figure 3 also shows sample of captured namic scan by ADAC gamma camera in different pa ing time of ^{99m}TC-ECD.

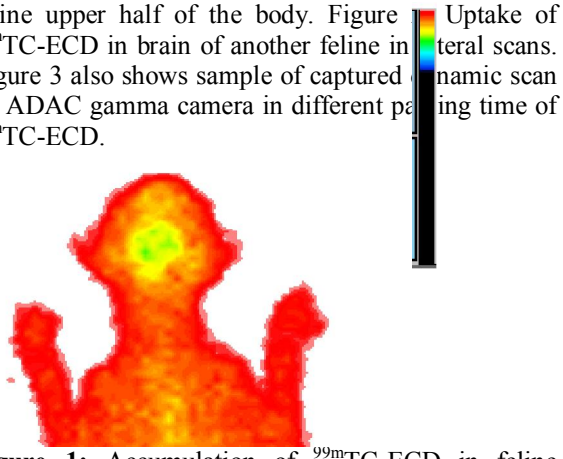

Figure 1: Accumulation of ^{99m}TC-ECD in feline upper half of the body

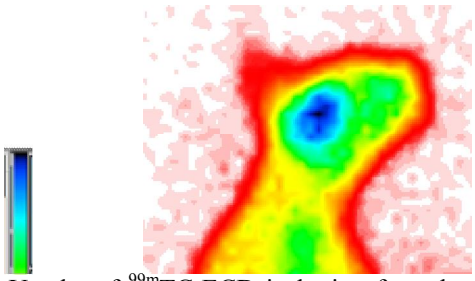

Figure 2: Uptake of ^{99m}TC-ECD in brain of another feline in lateral scans

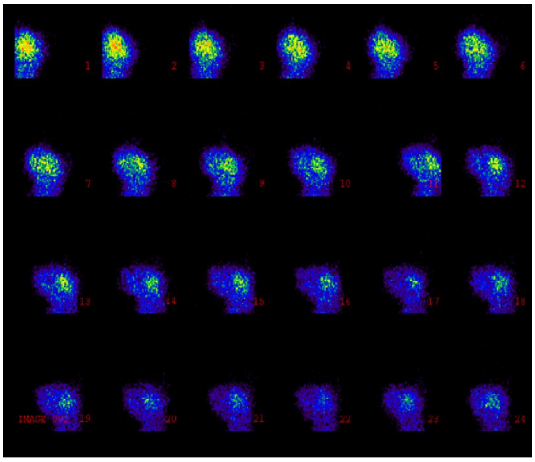

Figure 3: Sample of captured dynamic scans by ADAC gamma camera in different passing time of ^{99m}TC-ECD

4. Discussion

Brain scintigraphy needs to especial radiopharmaceutical agent to chelate with Technetium-99m. Scintigraphic images show the spatial distribution of the radiopharmaceutical agents such as ^{99m}TC-ECD. Complications such as non-symmetric imposes exchange the brain, delayed absorption of radioactive material in the skull and uniform parenchymal may be important in diagnosis. ^{99m}TC –ECD has being tracked by cameras order to accumulate a sufficient number of photons is contained in its structure (Awuawanne, 1995; Chang, 2002). This study shows, size, shape and position of the brain are possible by radionuclide imaging with ^{99m}TC-ECD. In Barthez study (Barthez, 2006) with ^{99m}TC-pertechnetate uptake in the feline head no focal area of uptake was identified in the brain but in recent survey we use ^{99m}TC-ECD successfully in brain imaging. Scintigraphy has been proposed and used in evaluating the functional and physiological activities (Henkink et al., 1996; Mettler, 1998). Scintigraphy is used in the animals (Balogh, 1999; Daniel, 1995; Chow, 2006; Hecht et al., 2010) especially in cats (Barthez, 2006; Hecht, 2008; Katsarov, 1979). Brain scintigraphy is done in cats for many purposes. Our results, also confirmed reports by other researchers, conducted at the cats scintigraphy of brain know that is consistent with reports in this field (Balogh, 1999; Barthez, 2006). ^{99m}Tc-ECD can be used in the brain scintigraphy (Chang, 2002; Daniel, 1995). In the cat study also revealed that this radiodrug can be used in scintigraphy of the animals, which compatible with the findings of other researchers (Balogh, 1999; Dykes, 1994). The use of this drug, reports of side effects like brain failure to respond to this medication, allergic and fatal side effects not being observed. In this study, the radioactivity count of right side of brain can be compared with the left. Brain scintigraphy revel the anatomical structure and physiological functions of brain which is reported previously (Daniel, 1995; Henkink et al., 1996). Even with assessment accumulation of ^{99m}TC-ECD in feline body in the scanned images it seems that scintigraphy can identify certain diseases of the brain which is supplementary in accurate diagnosis and is compatible with reports by other researchers (Chang, 2002; Daniel, 1995; Dewey, 2008; Dykes, 1994; Morrison, 2002). The investigation revealed, scintigraphy of cat brain with ^{99m}TC-ECD many similarities with human brain scintigraphy (Balogh,1999; Henkink et al., 1996) and computer programs such as scanning and collecting of images and drawing ROI in this animal also applied to be a particular and does not problem created. In assessment of obtained cat brain scans it revealed that accounting the radioactive agents is achievable and is done easily by computer programs of gamma cameras. ROI drawing in scans is performable by computer programs and applications of this technique in cats are possible and have no problem and it is like human plans. Execution and time steps of scintigraphy by computer in cats are similar with those done in human or can be assay by especial programs (Daniel, 1995; Henkink et al., 1996; Mettler, 1998). Scintigraphy considers as a method useful in diagnostic imaging and veterinary science. And from animals like cat can be used in medical research work and veterinary medicine as a specific animal models used in nuclear medicine research. The use of nuclear medicine techniques in animals can be very useful in researches. In finally, ^{99m}Tc-ECD radiodrug have excellent evaluate the efficacy in cat's brain scintigraphy.

Acknowledgement

The authors would like to thank the Tabriz Branch, Islamic Azad University, Research Department and Dr. Dabiri nuclear medicine center and Gama scan center.

References

1. Adams HR. Veterinary Pharmacology and Therapeutics, 8th ed., Iowastate University, Ames 2001; pp: 413-416, 445,472-475.
2. Awuawanne A. The hand book at radiopharmaceauticals, 1th ed., Champan and hall, London 1995;110-157.
3. Balogh L, Andocs G, Thuroczy J, Nemeth T, Lang J, Bodo K, Janoki GA. Veterinary Nuclear Medicine. Scintigraphical Examinations, Acta Vet Brno 1999;68:231–239
4. Barthez PY, Schaafsma IA, Pollak YW. Multimodality image fusion to facilitate anatomic localization of ^{99m}TC-pertechnetate uptake in the feline head. Vet Radiol Ultrasound 2006;47(5):503-6.
5. Chang C, Shiau Y, Wang J, Ho S, Kao, A. Abnormal regional cerebral blood flow on ^{99m}Tc ECD brain SPECT in patients with primary Sjögren's syndrome and normal findings on brain magnetic resonance imaging. Ann Rheum Dis 2002;61(9):774–778.
6. Chow PL, Stout DB, Komisopoulou E, Chatziioannou AF. A method of image registration for small animal, multi-modality imaging, Phys Med Biol 2006;51(2):379-90.
7. Daniel G, Twardock A, Tucker Rl. Brain scintigraphy. Prog Vet Neurol 1995;3:25.
8. Dewey CW. A Practical Guide to Canine and Feline Neurology, 2th ed., Willey, Iowa 2008;82-111.
9. Dykes NL, Warnick LD, Summers BA, Wallace R J, Kallfelz FA. Retrospective analysis of brain scintigraphy in 116 dogs and cats. Veterinary Radiology & Ultrasound 1994;35:59–65.
10. Dykes NL. Conventional (planar) brain scintigraphy. In: Berry C, Daniel G, Raleigh NC. Handbook of veterinary nuclear medicine. North Carolina State University 1996;133-137.
11. Ettinger A, Feldman EC. Textbook of Veterinary Internal Medicine, W.B.Saunders, 7th ed., London 2009; pp:346-350, 484-510, 1623-1624.
12. Hall LW, Clarke KW, Trim CM. Veterinary anesthesia, W.B. Saunders, 10th ed., London, 1998;pp:63-477.
13. Hecht S, Lane IF, Daniel GB, Orandi F, Sharp DE. Diuretic renal scintigraphy in normal cats. Veterinary Radiology and Ultrasound 2008;49(6):589-594.
14. Hecht S, Lawson SM, Lane IF, Sharp DE, Daniel GB. ^{99m}Tc-DTPA diuretic renal scintigraphy in cats with nephroureterolithiasis.J Feline Med Surg 2010;12(6):423-30.
15. Henkink R, Boles M, Dillehay G. Nuclear Medicine, Mosby – year book, St Louis 1996; pp:1055-1090.
16. Katsarov T, Nikolova M, Nikolov R. Scintigraphic and radiocirculographic studies on the effect of As2 on cat cerebral circulation, Acta Physiol Pharmacol Bulg 1979;5(1):47-51.
17. Mettler F. Essentials of Nuclear Medicinine Imaging, 4th ed., Saunders, Philadelphia 1998;pp:335-356.
18. Morrison WB. Cancer in Dogs and Cats: Medical and Surgical Management, 2th Ed., Teton New Media, China 2002;191:759,771.
19. Sutton D. Nuclear Medicine in radiology and imaging for medical students, Churchill living stone, Edingburgh 1998;pp:116-142.
20. Zolle I, Technetium-99m Pharmaceuticals: Preparation and Quality Control in Nuclear Medicine, Springer 2007;pp:10,61-65,300-303.