Somatostatin Receptor Tumor Imaging (Tc 99m P829) in Pituitary Adenoma

SUNANTA CHIEWVIT, M.D.*,
PAWANA PUSUWAN, M.D.*,
VACHARIN RATANAMART, M.D.*
PIPAT CHIEWVIT, M.D.**,
SUTHIN SRIUSSADAPORN, M.D.***,

Abstract

Technetium 99m P829 (^{99m}Tc P829) is a somatostatin like structure labelled with Technetium-99m. Somatostatin receptor positive tumors such as pituitary tumors, neuroendocrine tumors, and lymphomas show positive scintigraphy. Eleven patients suspected of having a pituitary mass (12 studies) were studied with ^{99m}Tc P829. Three pituitary adenoma patients (4 studies) showed positive somatostatin receptor tumor imaging. Eight negative somatostatin receptor scintigraphy were one hypothyroid induced pituitary hyperplasia, one craniopharyngioma, one normal pituitary tissue with focal hyperplasia, one ACTH secreting pituitary tumor, one GH, PRL secreting pituitary tumor post transphenoidal partial tumor removal, and no surgery in 3 patients. Finally, somatostatin receptor imaging may be useful as a tumor localizing technique in addition to conventional CT and MRI imaging and identify patients who might potentially benefit from octreotide treatment. In addition, the development of peptide analogs coupling to ß-emitting radiopharmaceutical may lead to a situation in which diagnosis peptide receptor scintigraphy can be followed by radionuclide therapy.

Key word : Somatostatin Receptor Tumor, Imaging, Pituitary Adenoma, Tc 99m P829

Somatostatin is a peptide hormone existing in two different forms, as 14 amino acid and as 28 amino acid molecules. Somatostatin receptors have been identified on many cells of neuroendocrine origin, such as somatotroph cells of anterior pituitary gland, pancreatic islet cells and thyroid C cells. However, nonneural and nonendocrine cells which comprise activated lymphocytes or the vasa recta of the kidney have somatostatin receptor. Five subtypes (somatostatin receptor subtype 1 to 5) of somatostatin receptors have been cloned. By Nuclear Medicine technique ^{99m}Tc P 829 competes with

* Division of Nuclear Medicine, Department of Radiology,
** Division of Diagnotic Radiology, Department of Radiology,
*** Department of Medicine, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.

somatostatin receptors in tumor cells. Most growth hormones (GH) and thyroid stimulating hormones (TSH) producing pituitary adenoma and several nonsecreting pituitary adenoma contain somatostatin receptor[1]. Somatostatin receptor has been demonstrated in a minority of prolactinomas, but not in ACTH or Gonadotropin secreting pituitary adenoma[2]. Endocrine tumor of the pancrease, tumor of gastrointestinal tract, small cell lung cancer, pheochromocytoma, paragangliomas and medullary thyroid cancer have high density of somatostatin receptor. Pituitary adenomas appear to express all five somatostatin receptor subtypes, with a particularly high level of somatostatin receptor subtype 2 and somatostatin receptor subtype 5[3-5]. Somatostatin receptor subtype 2 is extremely suitable for somatostatin receptor imaging with octreotide like ligands because human somatostatin receptor subtype 2 represents the subtype with highest affinity for octreotide.

MATERIAL AND METHOD

Patients

Eleven patients (five women and six men) ; aged 13-58 years; mean age 40 years with Computerized Tomography (CT) or Magnetic Resonance Imaging (MRI) suggested pituitary tumor. Except one patient who presented with hypothyroidism, hypogonadism and hyperprolactinemia. His MRI showed a normal pituitary gland.

Radiopharmaceuticals

^{99m}Tc P 829 20 mCi was intravenously injected 15 minutes before imaging. ^{99m}Tc P 829 was kindly supplied by Syncor international (Thailand) with the documentary proof of Ethical clearance commitee.

Image Acquisition and Processing

Scintigraphic plannar images (matrix 128x 128) were obtained in four views (anterior, posterior, both lateral) and SPECT (Single Photon Emission Computerize Tomography). Large field of view gamma camera (Toshiba GCA 901A) equipped with low energy general purpose collimator was acquired.

Table 1. Result of study.

Study number	Patients (gender/age)	Status of patient	Type of pituitary adenoma	CT or MRI	Scan
1	F, 39	Ptosis left eye	PRL secreting	CT: Macroadenoma (pre-op)	positive (pre-op)
2	M, 50	Loss of libido	Functionless	MRI: Macroadenoma (pre-op)	positive (pre-op)
3	M, 50	Post-transphenoidal partial tumor removal	Functionless	MRI: Macroadenoma (pre-op)	positive (post-op)
4	F, 29	Cushing's disease	GH, LH secreting	MRI: residual microadenoma (post-op)	positive (post-op)
5	F, 40	Cushing's disease	ACTH secreting	MRI: microadenoma (pre-op)	negative (pre-op)
6	F, 32	Cushing's disease	Normal pituitary tissue with focal hyperplasia	MRI: microadenoma (pre-op)	negative (pre-op)
7	M, 13	Bitemporal hemianopia	Craniopharyngioma	MRI: pituitary tumor with calcification Ddx craniopharygioma	negative (pre-op)
8	F, 48	Post-transphenoidal partial tumor removal	GH, PRL secreting	MRI: Macroadenoma (pre-op)	negative (post-op)
9	M, 47	Hypothyroidism, hyperprolactinemia	No surgery (improved clinical after eltroxin)	MRI: no mass of pituitary gland	nagative
10	M, 43	Acromegaly	No surgery	CT: pituitary cannot be excluded	negative
11	M, 45	Primary hyperparathyroidism	No surgery	MRI: microadenoma	negative
12	M, 58	Chondrosarcoma	No surgery	MRI: macroadenoma	negative

Ddx = Differential diagnosis

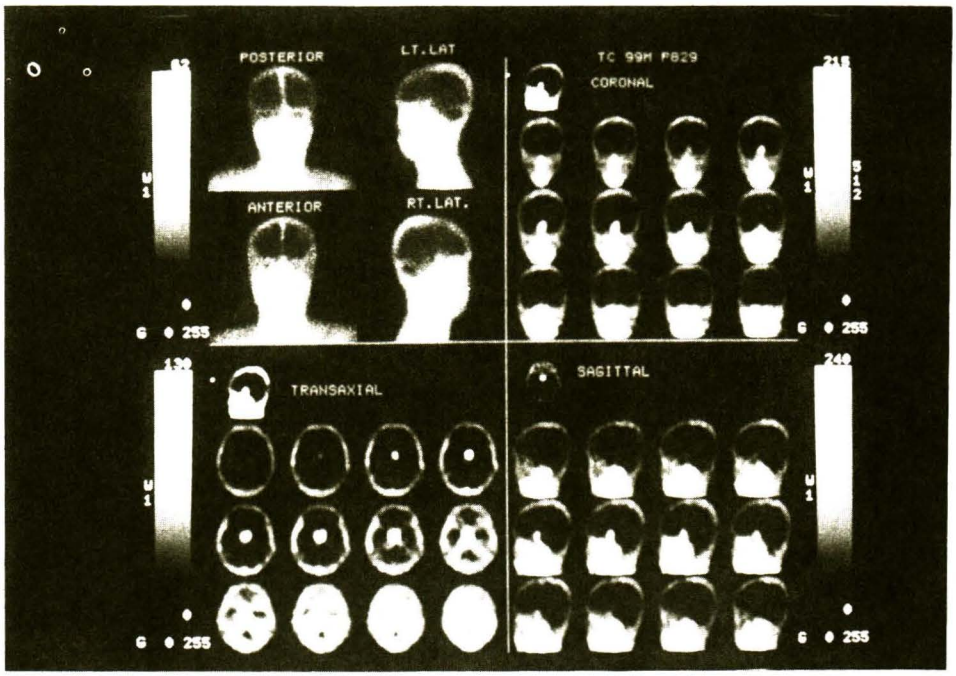

Fig. 1. Plannar and SPECT images at skull revealed positive somatostatin receptor imaging (^{99m}Tc P829) in a functionless pituitary adenoma.

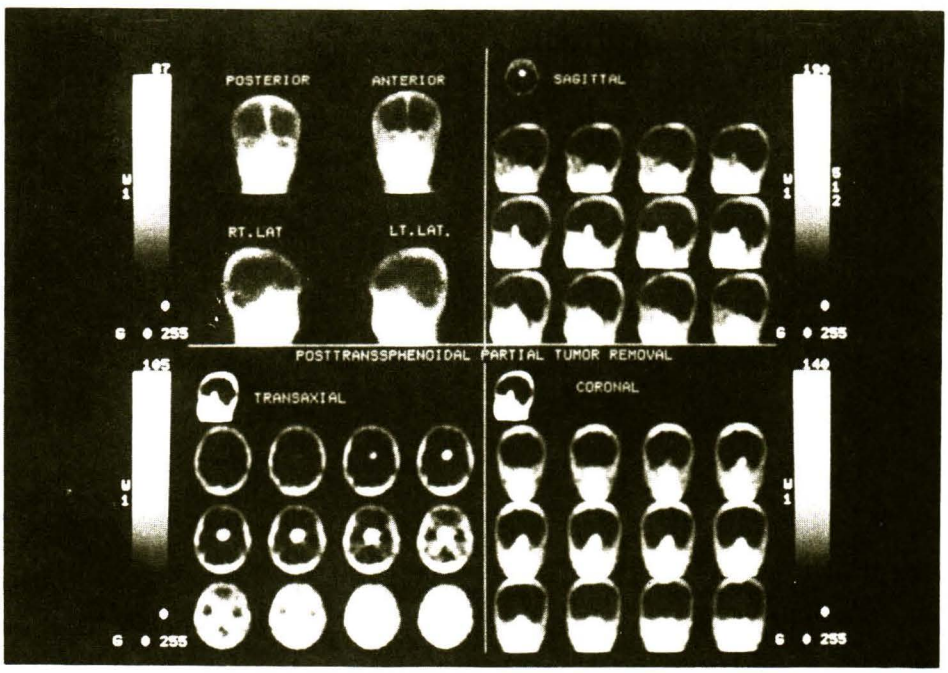

Fig. 2. Plannar and SPECT images at skull after transphenoidal partial tumor removal showed residual tumor uptake of ^{99m}Tc P829 in the same patient as Fig. 1.

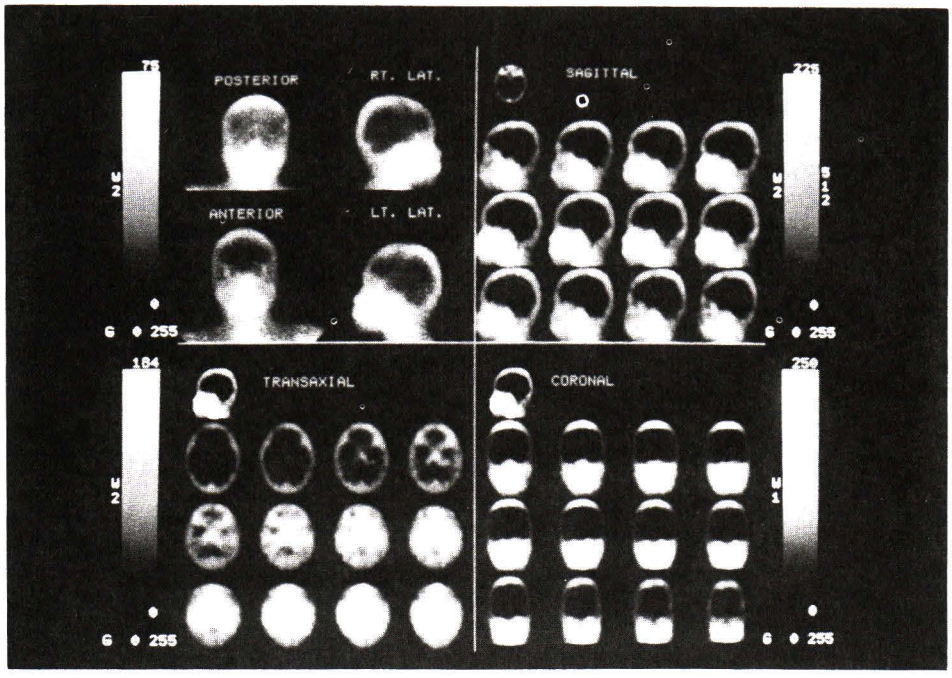

Fig. 3. Plannar and SPECT images at skull showed negative study in a craniopharyngioma patient.

RESULT

No side effects were observed after intravenous injection of ^{99m}Tc P829. There was positive somatostatin receptor tumor imaging in 4 studies (3 patients) with one prolactin secreting pituitary tumor, one nonfunctioning pituitary tumor and one GH, LH secreting pituitary tumor. Eight negative somatostatin receptor tumor imagings were studied. One case of negative somatostatin receptor imaging was ACTH secreting pituitary tumor. Normal pituitary with focal hyperplasia, craniopharyngioma had negative scintigraphy. A case of GH, PRL secreting pituitary tumor status post transphenoidal partial tumor removal revealed negative imaging. There was no post operative CT or MRI for correlation. Hypothyroid induced pituitary hyperplasia was the diagnosis of a case with negative somatostatin receptor imaging. No surgery at pituitary gland in 3 of 8 negative scintigraphy. One patient refused operation. Two patients had underlying chondrosarcoma of lung and primary hyperparathyroidism. Five cases of proven negative scintigraphy, true negative 3 cases were hypothyroid induced pituitary hyperplasia, normal pituitary with focal hyperplasia and craniopharyngioma. False negative 2 patients, ACTH secreting pituitary tumor had no somatostatin receptor. Post transphenoidal partial tumor removal of GH, PRL secreting pituitary tumor may have had no residual tumor or no receptor in tumor.

DISCUSSION

Van Royen et al[6] observed that the accumulation of ^{111} In DTPA octreotide in the pituitary gland is highly variable. In a normal population, they found that the level may vary about fivefold in the absence of pituitary disease. Patients with pituitary adenoma were significantly higher than in the healthy volunteers or in the patients without pituitary disoder. The scan positivity or negativity during in vivo octreotide scintigraphy is linked to the sensitivity of GH release to suppression by octreotide (2,7). The somatostatin receptor imaging will identify patients with functionless pituitary tumor positive for somatostatin receptor imaging who might potentially benefit from octreotide treatment[8]. Duel M et al[9] studied somatostatin receptor imaging in nonfunctioning pituitary adenoma had piui-

tary uptake index (UI) 15.1, 3.7, 2.2, 2.2, 2.2, 2.1. The UI of normal subjects were 1 and 1.1. The patient with UI 15.1 had dramatic improvement in tumor volume and visual function in respone to octreotide therapy. A recently available long acting somatostatin anolog, octreotide, has been used successfully to treat patients bearing neuroendocrine tumors[10-12]. Octreotide not only inhibited the secretion of specific hormone but also reduced the tumor size. Finally, application of radiolabelled somatostatin receptor for treatment of somatostatin receptor positive tumor is possible[8]. The use of in vivo scintigraphy will identify patients who might potentially benefit from octreotide treatment.

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การตรวจผู้ป่วยปิตุอิตารีย์ อะดีโนมา ด้วย somatostatin receptor tumor imaging Technetium 99m P829 (^{99m}Tc P829)

สุนันทา เชี่ยววิทย์, พ.บ., พิพัฒน์ เชี่ยววิทย์, พ.บ.**,*
ภาวนา ภูสุวรรณ, พ.บ., สุทิน ศรีอัษฎาพร, พ.บ.***, วัชรินทร์ รัตนมาศ, พ.บ.**

^{99m}Tc P829 คือสารที่มีโครงสร้างคล้าย somatostatin จับกับ Technetium-99M ^{99m}Tc P829 สามารถจับกับเนื้องอกที่มี somatostatin receptor เช่น pituitary tumor, Neuroendocrine tumor, และ lymphoma ผู้ป่วย 11 รายที่ได้รับการตรวจ Computerize Tomography หรือ Magnetic Resonance Imaging พบ pituitary mass ได้นำมาศึกษาด้วย ^{99m}Tc P829 ผู้ป่วย 3 ราย (4 การศึกษา) พบมีสารเภสัชรังสีสูงผิดปกติที่บริเวณ pituitary ผู้ป่วย 8 รายที่ไม่พบสารเภสัชรังสีบริเวณ pituitary 1 รายเป็น hypothyroid induce pituitary hyperplasia, 1 รายเป็น craniopharyngioma, 1 ราย เป็น normal pituitary with focal hyperplasia, 1 รายเป็น ACTH secreting pituitary tumor, 1 รายเป็น GH, PRL secreting pituitary tumor ศึกษาภายหลังการผ่าตัด และไม่ได้รับการผ่าตัด 3 ราย สรุปแล้ว somatostatin receptor imaging น่าจะมีประโยชน์ต่อผู้ป่วยในการช่วยวินิจฉัยร่วมกับการตรวจอื่น ๆ เช่น CT, MRI และช่วยบอกว่าผู้ป่วยรายใดที่มี uptake ของสารเภสัชรังสีที่จับกับ somatostatin น่าจะมีผลดีต่อการรักษาด้วย octretide รวมทั้งการพัฒนาสารที่มีโครงสร้างคล้าย somatostatin จับฉลากกับสารรังสีที่ให้รังสีเบต้าในการรักษาผู้ป่วยเนื้องอกที่มี somatostatin receptor

คำสำคัญ : Somatostatin Receptor Tumor, Imaging, Pituitary Adenoma, Tc 99m P829

* สาขาเวชศาสตร์นิวเคลียร์, ภาควิชารังสีวิทยา,
** สาขารังสีวินิจฉัย, ภาควิชารังสีวิทยา,
*** ภาควิชาอายุรศาสตร์, คณะแพทยศาสตร์ศิริราชพยาบาล, มหาวิทยาลัยมหิดล, กรุงเทพ ฯ 10700