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PUBTEXTO

Precise Investigation for Diabetic Patient with Recurrent Stroke by the Reconstruction Image of SYNAPSE VINCENT

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Abstract

Background: For recent radiological development, three-dimension (3-D) reconstruction image analysis has been in focus.

Patient and Method: The patient is a 63-year-old male with type 2 diabetes (T2D) and recurrent cerebral vascular accident (CVA). The computed tomography (CT) data were analyzed by SYNAPSE VINCENT system.

Results: Carotid artery and bone are simultaneously synthesized into an image. Precise image of right carotid artery was freely rotated in 0-110 degrees, in which the stenosis with calcification was detected at the bulbus of carotid artery.

Discussion: Consequently, this technique and evaluation method would be beneficial for diagnosis and treatment, expecting future development.

Keywords: Three-Dimension (3-D); Reconstruction Image Analysis; Synapse Vincent; Cerebral Vascular Accident (CVA); Artificial Intelligence (AI)

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Background

The authors and collaborators have continued clinical practice associated with various research for long [1]. The related regions include Integrative Medicine (IM), type 2 diabetes (T2D), non-communicable diseases (NCDs) [2,3]. Furthermore, development of radiological diagnosis such as three-Dimension (3-D) image analysis has been conducted and reported so far [4,5].

Along with the development of artificial intelligence (AI) worldwide, 3-D reconstruction image analysis has been used for various opportunities [6]. This technology has been applied associated with diagnostic radiological examination, such as computerized tomography (CT), magnetic resonance imaging (MRI) and Magnetic Resonance Angiography (MRA) [7]. For recent decade, rapid evolution of diagnostic method has been observed. Among our clinical practice, authors experienced an impressive male patient with T2D and recurrent cerebral vascular accident (CVA). His general clinical progress associated with radiological evaluation using reconstruction image method will be described in this article.

Case Presentation

History and Physicals

The patient is a 63-year-old male with T2D, obesity, hypertension, dyslipidemia, fatty liver and Gastro esophageal reflux disease (GERD) for more than 10 years. As the previous history, he was diagnosed as slight degree of CVA in 2018 and 2019. He has been a heavy smoker for 45 years, in which 60 cigarettes/day during 18-48 years and 5-10 cigarettes/day during 49-63 years. He has been strongly advised to quit smoking, but he cannot change his life style. Further, he has been a moderate drinker for long years.

As to his clinical progress for 2020-2022, his HbA1c has been in the range of 6.1% to 8.2% (Figure 1). He had the episodes of CVA twice in May 2020 and Mar 2021. His clinical symptoms and signs were not so heavy, and he can keep his ADL and QOL to the almost normal degree for years.

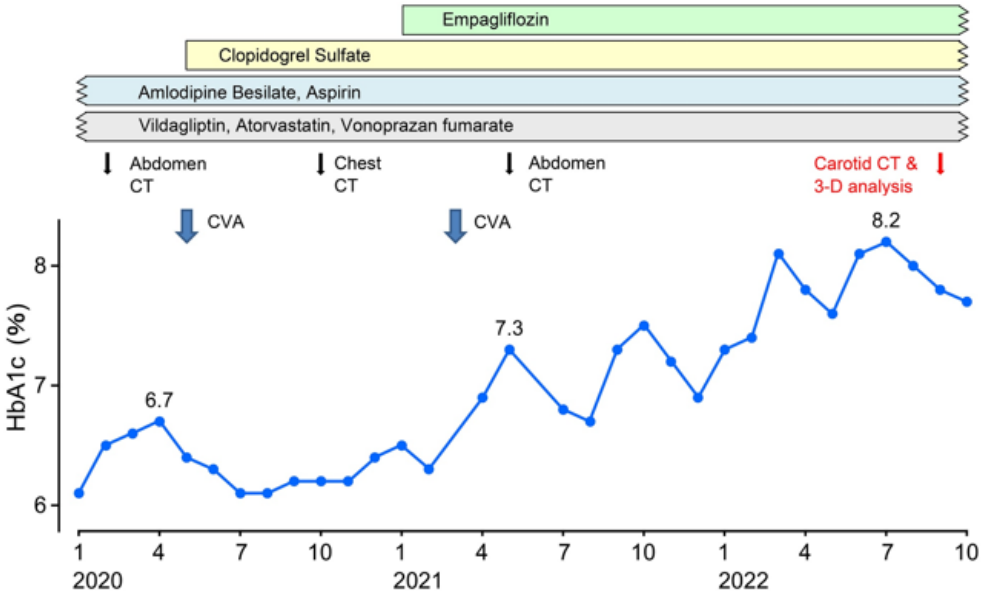

Figure 1: *Clinical progress of the case during 2020-2022.*

His general physical examination in Sept 2022 showed unremarkable findings. Consciousness alert, speech is normal, BP 132/70 mmHg, pulse 72/min, SpO_2 97%, head, neck, lung and heart were negative, abdomen is flat. Concerning neurological status, he did not have remarkable hemiparesis, motor disturbance, sensory disturbance or other diseased condition. His physique is stature 174 cm and weight 99.1 kg with BMI 32.7 kg/m^2.

Several Exams

As regards to his laboratory examination, his continuous data were summarized (Table 1). Unremarkable abnormalities were observed in fundamental exams. The results of chest X-P and electrocardiogram (ECG) were negative. He received other radiological exams in Jun-Aug 2022. Abdominal echogram showed fatty liver, gall stone with 8.5mm size, renal cysts in bilateral kidneys. Abdominal CT showed fatty liver, galls stone, small renal stone and calcification of aorta. Gastrofiber scope (GFS) examination showed chronic gastritis, small polyp, and scar of gastric ulcer. Helicobacter pylori was negative from histopathological examination. Head CT showed multiple cerebral infarction in wider area of the brain.

Table 1: *continuous laboratory data of the case.*

	Marker	Unit	Dec 2021	Mar 2022	Sep 2022
Liver	AST	U/L	22	25	27
	ALT	U/L	28	33	37
	r-GT	U/L	66	83	100
Lipids	LDL	mg/dL	118	144	114
	TG	mg/dL	130	108	125
	HDL	mg/dL	44	46	42
Renal	BUN	mg/dL	13	13	10
	Cre	mg/dL	0.8	0.9	0.9
	UA	mg/dL	4.8	4.5	4.3
Glucose	Glu	mg/dL	137	269	201
	HbA1c	mg/dL	6.9	8.1	7.8
CBC	WBC	x10`2	98	83	92
	RBC	x10`4	508	528	494
	Hb	g/dL	15.1	15.5	14.9
	Ht	%	47.1	46.8	45.3
	MCV	fL	92.5	88.6	91.7
	MCH	pg	29.5	29.4	30.2
	MCHC	%	31.9	33.1	32.9
	Plt	x10`4	25.8	27.4	23.7

Method for Reconstruction Analysis

For radiological diagnosis, reconstruction image method has been recently developed with clinical benefit [8]. Among several applications for computerized analysis, one of excellent procedure would be the SYNAPSE VINCENT of Fujifilm, Tokyo, Japan [9]. This radiological method has included some diagnostic imaging of CT, MRI and MRA for years [10]. Authors et al. have continued clinical research using this software so far. In this report, SYNAPSE VINCENT was applied for precise analysis of carotid CT scan associated with reconstruction of 3-D image method [11].

Results

The patient received CT scan of carotid artery in September, 2022. It was held in plain and contrast-enhancement by iopamidol. From these plain and enhanced data, 3-D reconstruction image analysis was performed. The results of these analyzed images are shown in Figure 2.

Reconstruction for both of carotid artery and bone are shown, in which frontal view cannot reveal remarkable findings (Figure 2a). Right carotid artery was rotated for 0, 60, and 75 degrees of right anterior oblique (RAO), in which the calcification lesion associated with probable stenosis was observed at the bulbus of carotid artery (Figure 2b). Enlarged views (80, 95, 110 degrees of RAO) showed the existence and calcification and stenosis (Figure 2c).

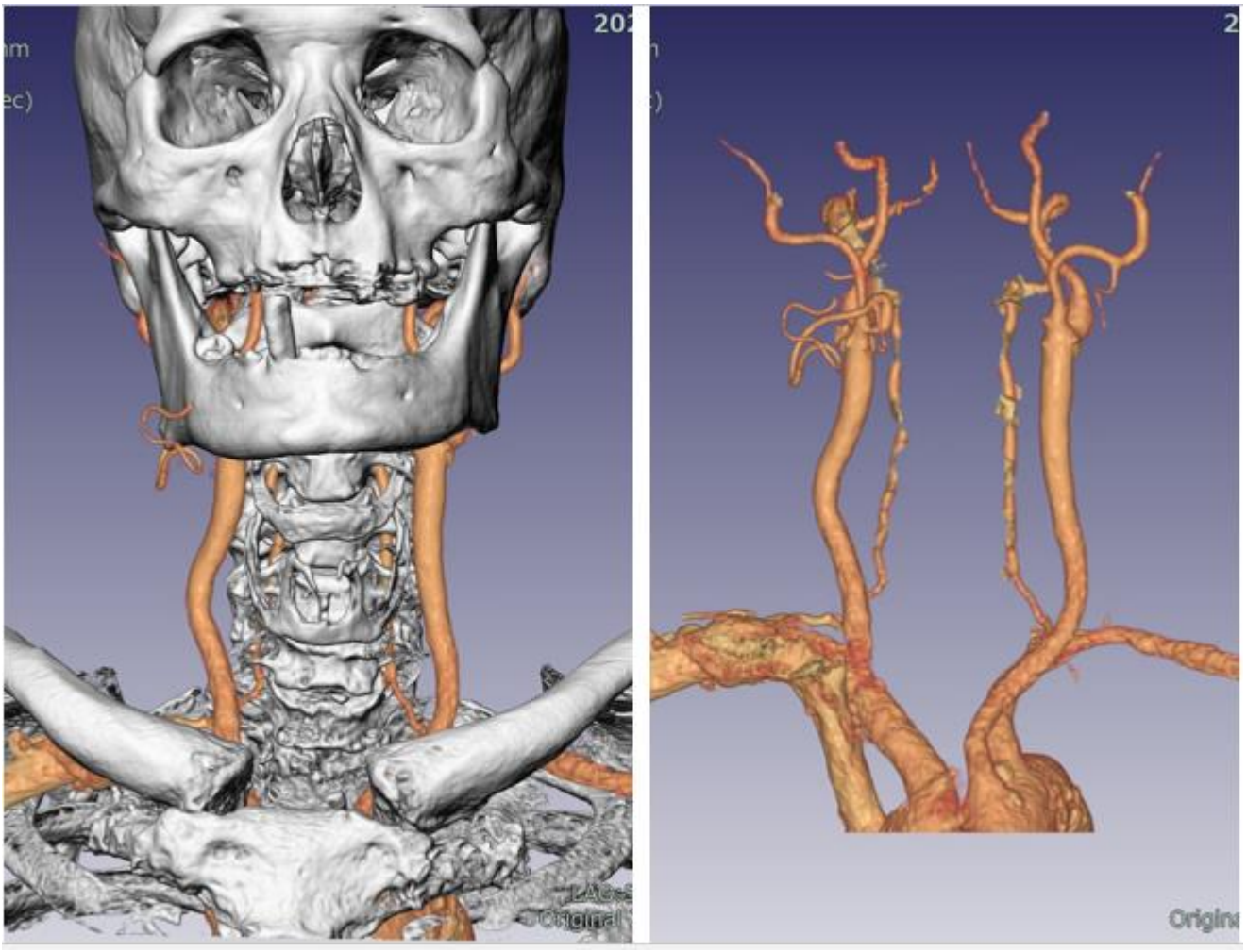

Figure 2: *Reconstruction image of 3-D analysis by the SYNAPSE VINCENT*

Figure 2a: *Carotid artery and bone are shown, in which frontal view cannot reveal remarkable findings.*

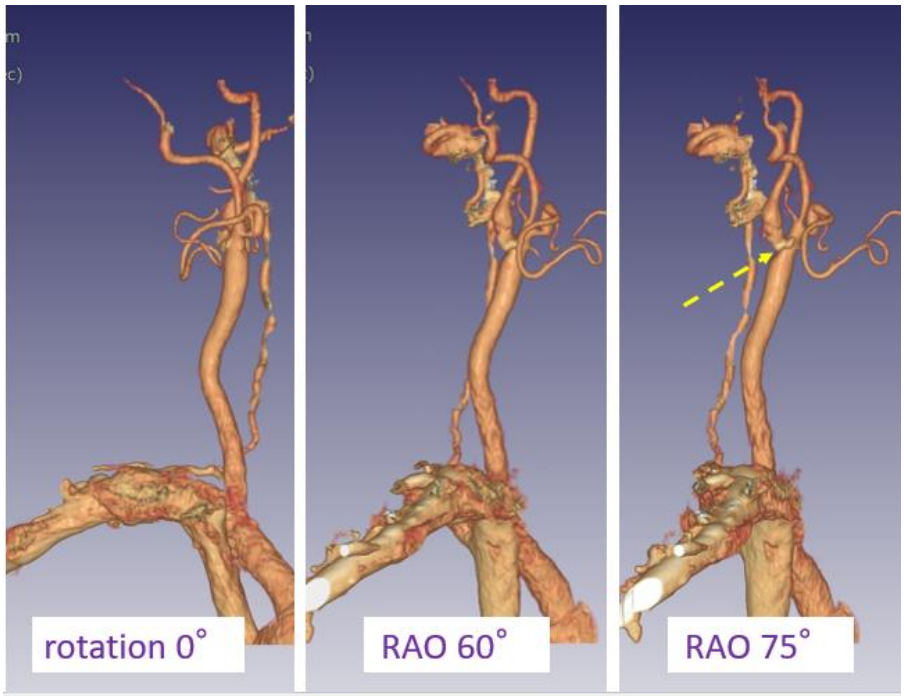

***Figure 2b**: Rotation views of right carotid artery, in which RAO 75 degree presents calcification lesion.*

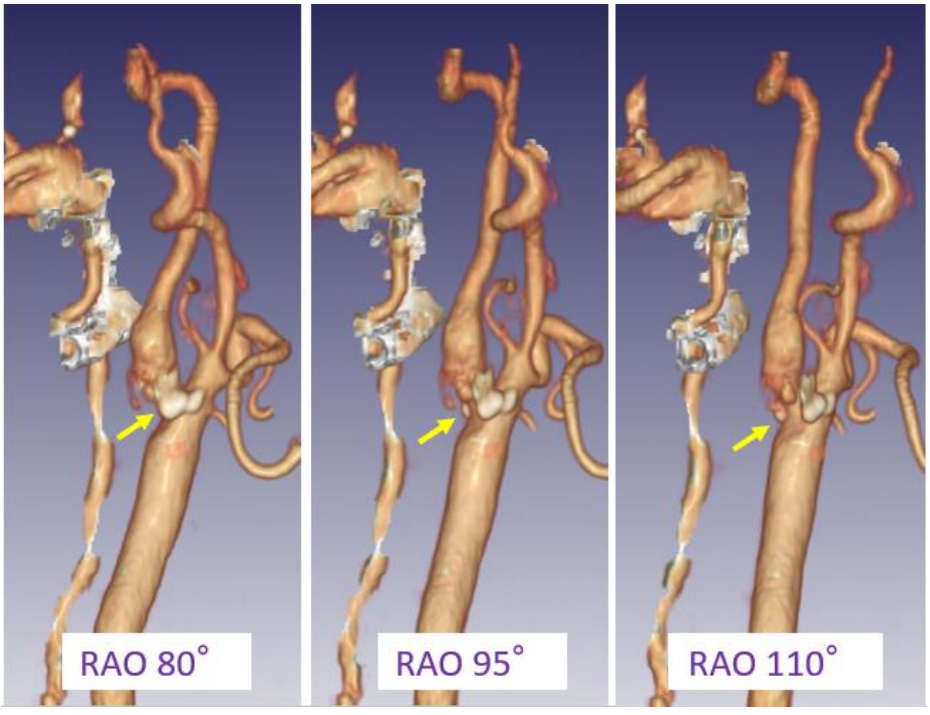

***Figure 2c**: Enlarged views (80, 95, 110 degrees) show the existence and calcification and stenosis.*

Discussion

For recent years, information and communication technology (ICT) has been developed in various regions. Deep learning technology with AI showed beneficial diagnostic procedure for 3-D image reconstruction method. This evolution was initiated from magnetic resonance cholangioscopy (MRCS) [12], orthopedic region [13], respiratory diseases [14], and to the arteriosclerotic diseases including CVA [6]. We can evaluate precise status of cerebral and carotid arteries associated with the 3-D analysis of the application of SYNAPSE VINCENT [10,15].

In this report, the patient has various medical problems. He has T2D, obesity, hypertension, dyslipidemia, fatty liver, GERD, recurrent CVA. The most crucial points would be the calcification and stenosis of right carotid artery that was clearly indicated by the reconstruction of 3-D image method of SYNAPSE VINCENT.

From his past history, he had four times of recurrent CVA from 2018 to 2021. He had often felt dizziness, vertigo, incomplete motor disturbance of upper and lower extremities. These symptoms and signs were almost improved until now. Concerning the latest CVA on Mar 2021, some triggers were suggested, which included starting empagliflozin 2 months ago, much alcohol drinking just before the onset, dehydration, and irregular lifestyle (Figure 1). Furthermore, he has continued smoking for 45 years, and cannot quit smoking regardless of our advice.

As regards to the current images by SYNAPSE VINCENT, several precise benefits can be found. The distribution of blood vessel associated with bone position can be easily understood (Figure 2a). The stenosis lesion cannot be observed in the plane of rotation 0, 60 degrees of RAO, but can be detected in 75 degrees (Figure 2b). Then, enlarged views for RAO 80, 95, 110 degrees enables us to detect the stenosis clearly (Figure 2c). Consequently, 3-D reconstruction image analysis may contribute much for the diagnosis, evaluation and treatment [16]. Further evolution would be expected associated with more prevalence of this technique.

Concerning acute angiopathy, large vessel occlusion (LVO) has been crucial problem in the clinical practice. For the research of LVO, internal carotid artery (ICA), the middle cerebral artery (M1) and basilar artery (BA) have been included, and radiological analyses were conducted [17]. Furthermore, flip-angle 3-D turbo spin-echo (VRFA-3D-TSE) method was also combined for detail analyses. The protocol included 27 cases, and the results showed that VRFA-3D-TSE MRI presented good and rapid depiction for the occlusion of distal vessels. Latest impressive evolution diagnostics have been reported. The image quality of MRA and vessel wall imaging (VWI) was evaluated by the newly-introduced BRIDGE method, which means bright and dark blood images with multi-shot gradient-echo EPI [18]. This novel method includes i) MRI part for T_2-preparation pulse and inversion-recovery pulse, and ii) three-dimension multi-shot gradient-echo EPI by navigator gating and pulse gating.

There are some limitations about this report. The case has T2D and the stenosis of carotid artery associated with other multiple medical problems. All biomarkers or related factors were not necessarily evaluated in detail yet. The obtained image should be followed up from various points of view, including three departments of internal medicine, neurosurgery and radiology.

In summary, a diabetic male case with recurrent CVA was presented with precise image by SYNAPSE VINCENT. Our medical team will treat the case carefully and expect that this report will be useful for medical practice and research.

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