Vascular Abnormalities in the Head and Neck Area in Velocardiofacial Syndrome

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Background: Velocardiofacial syndrome (VCFS) is a disorder commonly associated with a characteristic facial appearance, congenital heart disease, and velopharyngeal insufficiency. An association with vascular anomalies in the cervical area and skull base has been reported. In this study, we evaluated 7 consecutive patients who received vascular imaging for preoperative planning of velopharyngeal surgery.

Methods: From January 1996 to September 1997, 7 patients with VCFS were found in 1 of the senior author's service. All had documented velopharyngeal insufficiency and visible pulsations over the posterior pharyngeal wall by nasoendoscopy. Two patients had magnetic resonance angiography (MRA), 2 patients had computed tomographic angiography (CTA), and 3 patients had both.

Results: The angiographic study revealed abnormalities of the carotid and vertebral arteries in 5 patients (71%). Kinking and tortuosity of the internal carotid artery and its medial displacement were common. The observed pulsations did not correlate well with the angiographic findings. For surgical correction of the velopharyngeal sufficiency, a regular pharyngeal flap was used in 4 patients, a modified pharyngeal flap was used in 2 patients, and the surgery was abandoned in the remaining 1 patient.

Conclusions: Expression of cervical vascular anomalies in VCFS was varied and did not correlate well with the observed pulsations from the nasopharyngoscopic examination. Preoperative vascular imaging study is essential for the purpose of planning and safety of surgical interventions in this area.
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Key words: velocardiofacial syndrome, vascular anomaly, angiographic imaging.

Velocardiofacial syndrome is characterized by a complex of clinical manifestations resulting from an imbalance of normal dosage genes located on 22q11. It is also known as DiGeorge or 22q11 deletion syndrome (DGS/22qDS), and is a disorder associated with a characteristic face, congenital heart disease, learning disability, and frequently a submucosal or overt cleft palate, leading to velopharyngeal insufficiency (VPI).[1-9] In addition to cardiac anomalies, vascular abnormalities have been noted.

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Pulsation over the lateral and posterior pharyngeal wall is a frequent finding seen in these patients during surgical procedures or nasopharyngoscopic examinations. Medial displacement of the internal carotid artery (ICA) has been documented by conventional angiography and magnetic resonance angiography (MRA).[10-12] Vascular injury is a potential risk and may be fatal during velopharyngeal procedures in this group of patients, since it is indicated for correction of speech dysfunction. There has been a paucity of critical studies evaluating the relationship between pharyngeal pulsation and vascular anomalies in patients with VCFS. As CTA and MRA have become reliable and convenient tools for screening vascular anomalies, we have been using them for preoperative assessment in patients with VCFS. The purpose of this study is to report on 7 consecutive VCFS patients in order to evaluate (1) the vascular anomalies in the head and neck region, and (2) the correlation between pharyngeal pulsation and medial displacement of the ICA.

METHODS

From January 1996 to September 1997, 7 patients in 1 of the senior author's service were found to have velocardiofacial syndrome. A diagnosis was made by the craniofacial team (including plastic surgeons and speech pathologists) based on the typical facial appearance (Fig. 1), a history of congenital heart disease, and the presence of velopharyngeal insufficiency. The characteristic facial appearance included a prominent nose, malar flatness, small and cupping auricles, downward mouth angles, and retruded chin. Conventional chromosome study of these patients revealed normal karyotypes. No fluorescence in situ hybridization study (FISH) was available during the study period for detection of microdeletions. At present, this service is routine for VCFS. They were 3 males and 4 females, and their ages ranged from 3 to 11 (mean, 6.9) years. For the sake of hypernasality speech, these patients received a fiberoptic nasopharyngoscopic (NPS) examination for assessment of velopharyngeal function. Velopharyngeal insufficiency was confirmed. Obvious posterior pharyngeal pulsation was seen in all of these patients on the NPS study. CTA or MRA were arranged to obtain vascular information before planning the velopharyngeal surgery. Consent forms were obtained for the imaging studies. Two patients had MRA only, 2 patients had CTA only, and 3 patients had both CTA and MRA. The angiographic imaging findings were carefully interpreted and compared by the authors.

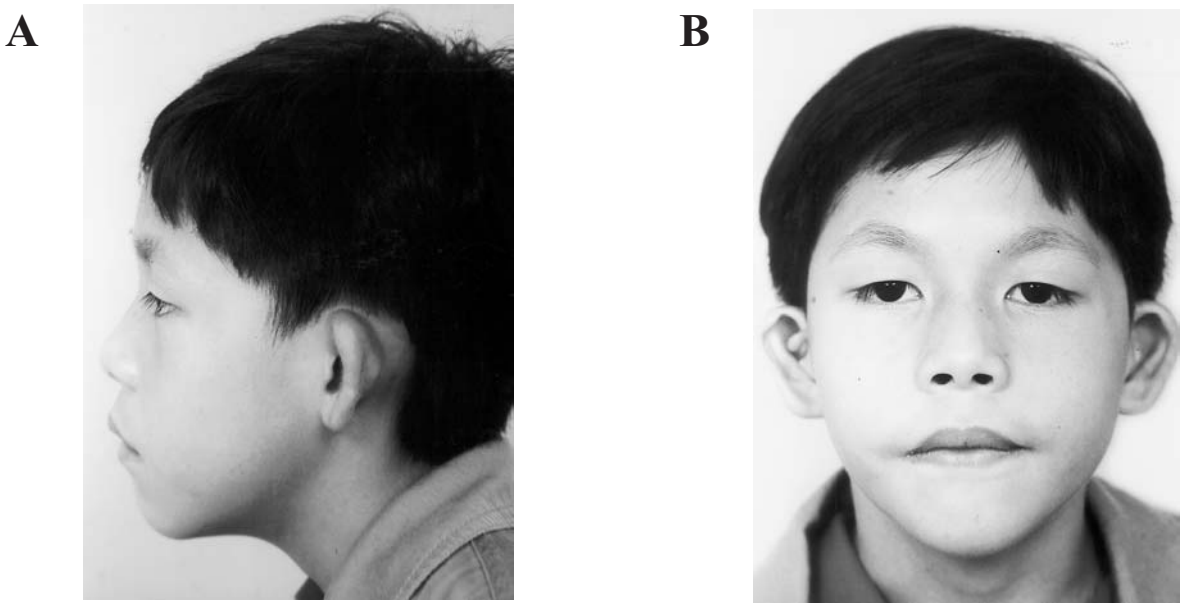

Fig. 1 Typical facial appearance of patient no. 1 with velocardiofacial syndrome. Note the broad nose, epicanthal folds, small chin, downward mouth angle, and prominent ear.

RESULTS

The charts of the 7 cases and patient photos were reviewed. All of these cases had typical facial features which make up a diagnosis of VCFS, including a broad nasal root, cupped low-set ears, down-turned mouth angles, slant eye fissures, and a retruded chin. Two cases had congenital heart disease: one with an atrial septal defect (ASD), and the other with a small ASD and pulmonary stenosis. Three cases were diagnosed as having congenital VPI without clinical signs of a cleft palate, while another 3 cases had a submucosal cleft palate. The remaining case had a repaired cleft palate and VPI. Five cases suffered from learning disability, 2 of whom had mental retardation. Five MRA and 5 CTA procedures were performed on the 7 cases. The MRA and CTA findings are summarized in Table 1. Some typical findings of CTA and MRA are shown in Fig. 2. Carotid artery anomalies were found in 5 cases. The most common findings were kinking and tortuosity of the carotid artery (4 of 7). Low carotid bifurcations were found in 2 cases, with the level of bifurcation occurring below the 4th cervical vertebral body. Two patients had a hypoplastic ICA, as compared to the same vessel on the opposite side. Medial displacement of the ICA was noted in 3 patients. Two patients had kinking and tortuosity of the vertebral arteries, which were found by MRA. It would seem that CTA was not a reliable diagnostic tool for vertebral arteries, as no abnormalities of vertebrobasilar vessels were noted with that procedure.

Although pulsation in the pharyngeal wall was seen by nasopharyngoscopy in all patients in this series, medial displacement of the ICA was found in only 3 cases by either MRA or CTA. Most of the findings of vessels presenting on MRA and CTA were similar and correlated (case nos. 3-5), but the level of bifurcation of the carotid artery was more-easily observed on CTA than MRA images. CTA also identified 2 cases of low-set bifurcation, but none was seen with MRA. Both MRA and CTA could clearly identify the course of the internal and external carotid arteries.

Table 1. Summary of Clinical Presentations & MR/CT Angiography Findings

	Patient							
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	Total
Typical facial features	Y	Y	Y	Y	Y	Y	Y	7
Mental retardation	+	+	-	-	-	-	-	2
Learning disability	+	+	+	+	-	-	+	5
Congenital heart disease	-	ASD	-	-	-	?	ASD + PS	2
Cleft palate	RCP	SCP	SCP	CVPI	SCP	CVPI	CVPI	3CVPI, 3SCP, 1RCP
VPI	+	+	+	+	+	+	+	7
Pulsation on PPW	+	+	+	+	+	+	+	7
Angiography	M	M	M/C	M/C	M/C	C	C	5M/5C
Findings of angiography								
Carotid artery								
Level of bifurcation	C23	?	?/C56	?/C4	C45/C6	C34	C3	2 below C5
Medial placement	+		+		?/+			3
Hypoplasia		+			+			2
Kinking & tortuosity	+	+	+/+		-/+	+		5
Normal				*/*			*	2
Vertebral artery								
Kinking & Tortuority	+				+/?			2
Normal		*	*/*	*/*		*	*	5
Surgery	SPF	RPF	Nil	SPP	SPP	RPF	RPF	3RPF, 2SPP, 1SPF, 1Nil
Post-OP VP	VPC	VPC	VPI	VPC	VPC	VPC	VPM	5VPC, 1VPM, 1VPI

Abbreviations: ASD: Atrial septal defect; PS: Pulmanary stenosis; RCP: Repaired cleft palate; SCP: Submucous cleft palate; CVPI: Congenital VPI; PPW: Posterior pharyngeal wall; M: MR angiography; C: CT angiography; SPF: Small pharyngeal flap; RPF: Regular pharyngeal flap SPP: Sphincter plasty; Nil: operation abandoned; VPC: Velopharyngeal competence; VPM: Marginal velopharyngeal competence.

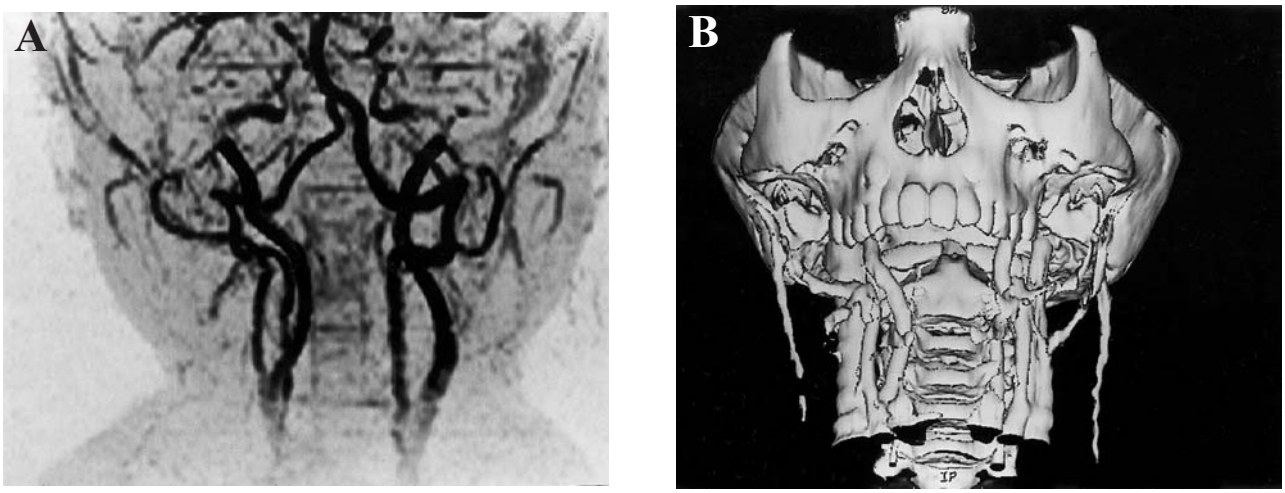

Fig. 2 Typical findings of vascular anomalies in patient no. 5 shown by CTA (B) and MRA (A).

A pharyngeal flap was used or sphincter pharyngoplasty, as recommended by speech pathologists, was performed in 4 patients whose angiographic study revealed no medial displacement of the ICA. For those 3 cases with medial displacement of the ICA, different operations were performed. A reduced-width, modified pharyngeal flap was used to avoid the vessel in 1 patient with medialized ICA (case no. 1). One patient (case no. 5) received sphincter pharyngoplasty. For case no. 3, both the preoperative MRA and CTA revealed medial displacement of the right ICA. The maximal displacement, which was close to the midline on the film, occurred at the C2-3 level. During the operation, strong submucosal pulsations at the paramedial aspect of the posterior pharyngeal wall were palpated; 2 other experienced cleft surgeons in this craniofacial center were called to examine and discuss it, and a decision was made to abandon the planned pharyngeal flap procedure. An attempt at Furlow's Z-plasty for soft palate lengthening in this particular patient was also precluded because the soft palate was very thin. However, a biopsy was done, and normal muscle appearance was found histologically. The use of a speech-prosthesis was denied. For all other patients, the operations were smoothly performed with no surgical complications. Blood loss was not significant in any patient. Speech evaluation was performed 3 months after surgery for the first time, then repeatedly every 6 months for at least 1 year. Because learning disability and mental retardation are commonly associated problems in these patients, speech outcomes were difficult to evaluate. However, the VP competency ratio could be checked by NPS. Postoperative NPS was carried out in all but 1 case at 1 year after surgery. One of those 4 patients with no medialized ICA had marginal VP competence. The other 2 patients who had a medialized ICA but who underwent modified surgery achieved competent velopharyngeal function after surgical intervention.

DISCUSSION

In 1978, Shprintzen et al. reported the first series of 12 patients with special facial characteristics of a cleft palate and velopharyngeal insufficiency, a history of congenial heart disease, and learning disability.[1] Velocardiofacial syndrome has been recognized as a common, if not the most-frequent, syndrome seen in cleft and craniofacial centers.[2] Recently, microdeletions of chromosome 22q11 have been reported in patients with VCFS, and the fluorescence in situ hybridization method is used to detect the deletions.[4-9] MacKenzie-Stepner et al.[10] reported the aberrant course of the ICA, particularly its medial placement, as being associated with the velocardiofacial syndrome. They considered this anomaly to be a contraindication to pharyngeal flap surgery to prevent potentially fatal complications.

D'Antonio and Marsh suggested that all patients with VCFS receive a nasopharyngoscopic examination prior to pharyngeal flap surgery in order to detect possible carotid anomalies.[11] Due to the medical and technical hazards associated with conventional angiography with contrast medium, the introduction of MRA and CTA imaging methods was welcomed for screening head and neck vessels.[13-16] The 3D reconstruction of medical images makes the interpretation of vessel location and their spatial relationship with adjacent structures straightforward. Both are ideal tools to examine vascular abnormalities in children with VCFS. In MacKenzie-Stepner's series, anomalous carotid arteries were confirmed by conventional angiography in 2 cases. In Goldberg's review of 120 cases of VCFS in 1993, 25% of those patients had medial placement of the ICA. Most of them were observed by NPS findings, with only 4 cases by MRA. In 1996, Mitnick et al. used MRA to detect vascular anomalies in VCFS patients, and they found that all patients had anomalous neck vessels. Medial placement of the ICA was found in 55% of cases. In their study, there was no apparent correlation between the NPS-observed pulsation and medial placement of the ICA. Tortuosity and kinking of the vertebral arteries were found in all patients. In a later report, Ross et al. used CTA to assess the vascular anomalies in 25 cases of VCFS who had a pharyngeal pulsation by NPS. The ICA was found to deviate medially in each patient, though to varying degrees. In their series, NPS was reported to have a high degree of accuracy in detecting these carotid artery anomalies. In contrast to Mitnick et al.'s series, they found no abnormalities of the vertebral vessels in their patients. For VCFS patients, questions not clearly clarified include (1) the general pattern of vascular anomalies in the head and neck region, (2) the correlation between visible pulsations and actual vessel displacement, and (3) the selection of patients at risk for velopharyngeal surgery.

The results of this study showed that all 7 consecutive patients had visible pulsations over the posterior pharyngeal wall, but only 3 patients had ICA medialization as noted by MRA and/or CTA. Obviously, the presence of pulsation did not predict underlying vessel anomalies. A similar observation was reported by Mitnick et al. The appearance of pulsation might be altered by such factors as head position, blood pressure, and a patient's reaction to the endoscopic procedure. However, its appearance should draw the attention of surgeons before planning the velopharyngeal procedure. This study failed to reveal a consistent or specific pattern of vascular anomalies in VCFS, as shown Table 1. Kinking and tortuosity of the ICA occurred most frequently in 57%, medial displacement of the artery in 43%, and vertebral artery abnormality in 29% of patients.

In our 3 cases who received both MRA and CTA (patient nos. 3-5), the vascular findings in both examinations were almost the same except in patient 5. In this patient, the MRA procedure could not identify the anterior and lateral bowing of the right ICA that was noted by CTA, but MRA disclosed the vertebrobasilar artery anomalies that CTA did not. Comparatively, MRA does not integrate the vascular roadmap with the surrounding anatomy. Consequently, it is difficult to determine the exact level of the vascular anomalies with respect to neighboring bony and soft tissue structures, which is important as an intraoperative guide for an anomalous ICA. Overall, MRA is useful for screening the vascular system, and CTA is helpful for assessing the carotid artery and its related adjacent structures. The information obtained from such medical imaging is essential for planning surgery in order to avoid massive bleeding.

A diagnosis of VCFS should serve as a caution, instead of a contraindication, to velopharyngeal surgery. The surgeon should be careful when there is medial displacement of the ICA on medical imaging. Modification of the pharyngeal flap procedures should be made in order not to injure the vessel.[17-20] During the operation, a finger was used to palpate the artery while incising on the posterior pharyngeal wall. The recommended width of the pharyngeal flap could be achieved by skewing the flap to the side contralateral to the abnormal vessel, the eccentric pharyngeal flap. This was the situation in patients 1 and 2. For patient 3, the pulsating artery was more medially and superficially located at the C2 level (Fig. 3). The beating vessel was felt very close to the surgeon's fingertip. The operation was therefore abandoned. Similar situations were reported previously.[8,9] In this particular patient, hypoplasia of the soft palate was incidentally found, as indicated by its reduced thickness. In patients with endoscopically and intraoperatively visible pulsations (patients 4 to 7), the artery was not palpable at all by placing a fin-

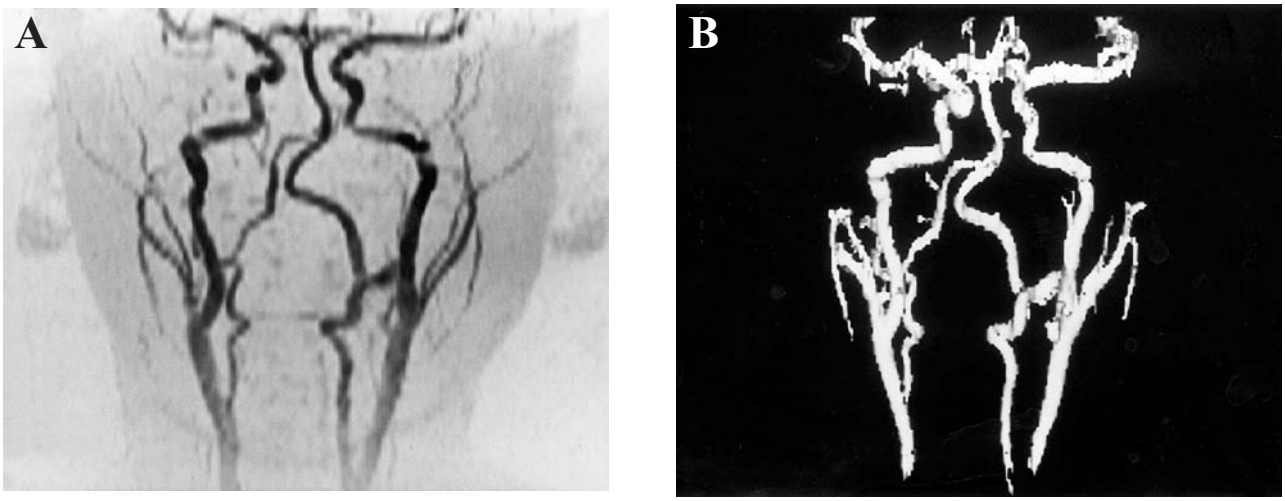

Fig. 3 Medial deviation of the left internal carotid artery in patient no. 3. Tortuosity and kinking of the vertebrobasilar arteries are shown in this MRA study (A) compared with the same patient's CTA (B), showing marked deviation of the internal carotid artery at the C2 level but no presentation of the vertebrobasilar system.

gertip on the posterior pharyngeal wall.

In conclusion, velocardiofacial syndrome has a high incidence of vascular anomalies in the head and neck area. Visible pulsation over the posterior pharyngeal wall does not correlate well with medial displacement of the internal carotid artery, nor predict the underlying vessel abnormality. The presence of an aberrant course of the internal carotid artery could only be recognized by vascular imaging studies. Although there has been no report of fatal hemorrhagic complication during velopharyngeal surgery on VCFS patients, this does not preclude that caution should be exercised. MRA is useful in screening vascular abnormalities. CTA with 3D image reconstruction is superior for displaying spatial anatomical relationships, especially in the upper cervical spine area where a pharyngeal flap is to be raised. Surgical safety, as well as satisfactory outcomes, can be achieved with preoperative vascular imaging studies and a careful operation.

REFERENCES

1. Shprintzen RJ, Goldberg RB, Lewin ML, Sidoti EJ, Berkman MD, Argamaso RV, Young D. A new syndrome involving cleft palate, cardiac anomalies, typical facies, and learning disabilities: Velocardiofacial syndrome. Cleft Palate J 1978;5:56.
2. Goldberg R, Motzkin B, Marion R, Scambler PJ, Shprintzen RJ. Velocardiofacial syndrome: A review of 120 patients. Am J Med Genet 1993;45:313.
3. Shprintzen RJ, Goldberg RB, Young D, and Wolford L. The velocardiofacial syndrome: A clinical and genetic analysis. Pediatrics 1981;67:167-72.
4. Vogels A. Fryns JP. The velocardiofacial syndrome: a review. Genet Counsel 2002;13:105-13.
5. Yonehara Y. Nakatsuka T. Ichioka S. Sasaki N. Kobayashi T. CATCH 22 Syndrome. J Craniofac Surg 2002;13:623-6.
6. Lindsay EA. Chromosomal microdeletions: dissecting del22q11 syndrome. Nat Rev Genetics 2001;2:858-68.
7. Motzkin B, Marion R, Goldberg R, Shprintzen R, Saenger P. Variable phenotypes in velocardiofacial syndrome with chromosomal deletion. J Pediatr 1993;123:406-10.
8. Driscoll DA, Salvin J, Sellinger B, Budarf ML, McDonald-McGinn DM, Zackai EH, Emanuel BS. Prevalence of 22q11 microdeletions in DiGeorge and velocardiofacial syndromes: implications for genetic counselling and prenatal diagnosis. J Med Genet 1993;30: 813-7.
9. Reish O. Finkelstein Y. Mesterman R. Nachmani A. Wolach B. Fejgin M. Amiel A. Is isolated palatal anomaly an indication to screen for 22q11 region deletion?. Cleft Palate-Craniofac J 2003;40:176-9.
10. MacKenzie-Stepner K, Witzel MA, Stringer DA, Lindsay WK, Munro IR, Hughes H. Abnormal carotid arteries in the velocardiofacial syndrome: A report of three cases. Plast Reconstr Surg 1987;80:347-51.
11. D'Antonio LL, and Marsh JL. Abnormal carotid arteries in velocardiofacial syndrome (Letter). Plast Reconstr Surg 1987;80:471.

12. Witzel MA, Posnick JC. Patterns and location of velopharyngeal valving problems: Atypical findings on video nasopharyngoscopy. Cleft Palate J 1989;26:63-7.
13. Mitnick RJ, Bello JA, Golding-Kushner KJ, Argamaso RV, Shprintzen RJ. The use of magnetic resonance angiography prior to pharyngeal flap surgery in patients with velocardiofacial syndrome. Plast Reconstr Surg 1996;97:908-19.
Sheppard S. Basic concepts in magnetic resonance angiography. Radiol Clin North Am 1995;33:91-113.
14. Zeman RK, Silverman PM, Vieco PT. Costello P. CT angiography, AJR 1995;165:1079-88.
15. Korosec FR. Turski PA. Carroll TJ. Mistretta CA. Grist TM. Contrast-enhanced MR angiography of the carotid bifurcation. J Magnet Reson Imag. 1999;10:317-25.
16. Witt PD, Miller DC, Marsh JL, Muntz HR, Grames LM. Limited value of preoperative cervical vascular imaging in patients with velocardiofacial syndrome. Plast Reconstr Surg 1998;101:1184-95.
17. Ross DA, Witzel MA, Armstrong DC, Thomson HG. Is pharyngoplasty a risk in velocardiofacial syndrome? An assessment of medially displaced carotid arteries. Plast Reconstr Surg 1996;98:1182-90.
18. Shprintzen RJ, Lewin ML, Croft CB, Daniller AI, Argamaso RV, Ship AG, Strauch B. A comprehensive study of pharyngeal flap surgery: tailor made flaps. Cleft Palate J 1979;16:46-55.
19. Tatum SA 3rd, Chang J, Havkin N, Shprintzen RJ. Pharyngeal flap and the internal carotid in velocardiofacial syndrome. Arch Facial Plast Surg 2002;4:73-80.

腭心面徵候群患者在頭頸部之血管異常

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背 景： 腭心面徵候群是顎裂患者最常發生的徵候群，這群病患常有臉部的特徵合併先天性心臟病及顎咽閉鎖不全等症狀。曾有文獻報告合併頸部及顱部血管變異，但未有同時以核磁共振血管攝影術與三度空間立體血管攝影術檢測這些異常的研究，故以7位診斷爲腭心面徵候群患者顎咽手術前之血管攝影檢查做血管異常三度空間立體關係之研究。

方 法： 從1996年至1997年間資深主治醫師的病患中有7位病人診斷爲此徵候群。所有病人因爲顎咽閉鎖不全皆接受鼻咽鏡檢查，且發現其咽喉後壁皆呈現強烈脈搏跳動。7位病人中有2位接受核磁共振血管攝影術，兩位接受電腦斷層血管攝影術檢查其頭頸部的血管，有3位兩項檢查都做。

結 果： 血管攝影術發現7人中只有5人之頸動脈或脊椎動脈系統發生異常 (71%)，3人有內頸動脈在頸部往內偏移之現象，甚至有1人之內移現象嚴重影響咽喉後壁手術之進行，必須變更手術方式以維患者安全。

結 論： 根據本篇報告研究顯示，腭心面徵候群患者出現頸部大血管異常的比例甚高，但頸動脈內移的現象並未與鼻咽鏡檢觀察到之咽喉後壁博動現象呈相關關係。然而腭心面徵候群患者接受咽喉部手術前利用核磁共振血管攝影檢查頸部血管，仍有其重要性。

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關鍵字： 腭心面徵候群，血管攝影術，血管異常。

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