Case report

Successful conservative therapy for blunt trauma of both the right subclavian artery and vertebral artery – A case report –

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Abstract: Thoracic outlet injury is challenging to treat because the thoracic outlet is close to many important nerves and vessels. A 21-year-old man was transferred to our department because of blunt trauma to both the right cervix and right thoracic outlet. The patient's vital signs were stable, but a lack of pulse was noted in the right radial and brachial arteries. Neither cyanosis nor neurological dysfunction was detected. Angiography showed severe stenosis of the right subclavian artery (SCA) and obstruction of the right vertebral artery (VA). Significant anatomic and symptomatic improvement was achieved with conservative therapy. However, although the right VA was completely occluded, blood flow to the peripheral lesion was maintained due to collateral circulation from the left VA via the basilar artery. In conclusion, conservative therapy may be an effective therapeutic option for young patients without arteriosclerosis and SCA injury-related ischemic symptoms, despite simultaneous injury to the SCA and VA. Careful long-term follow-up is necessary because pseudoaneurysm or thrombotic occlusion might occur after traumatic SCA injury.

Key words: blunt vascular injury / angiography / thoracic outlet / blunt neck injury

INTRODUCTION

Simultaneous injury of the subclavian artery (SCA) and vertebral artery (VA) caused by blunt trauma is rare, as both arteries are protected by the clavicle and the first rib, and thick connective tissue including the deep cervical fascia, cosco-thoracoid ligament, and clavi-thoraco-axillary fascia.[1, 2)]

SCA injury often results in fatal hemorrhage and/or serious thromboembolism; therefore, surgery with artificial bypass grafting or endovascular stenting may be performed in case of SCA injury.[3)] Moreover, intravenous heparin infusion or administration of oral anticoagulants, including warfarin and anti-coagulation factor (Xa or thrombin) inhibitors, may be selected as optional treatments for preventing thromboembolism.

The symptoms of arterial injury depend on the location of the injury. The major symptoms of SCA injury, including pain, pallor, poikilothermia, paralysis, and weakness of the pulse of peripheral arteries, are caused by ischemia of the upper limb.[2)] On the other hand, the common symptoms of VA injury are caused by cerebellar

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or brainstem ischemia and include headache, neck pain, vertigo or dizziness, nausea, and vomiting.[3, 4] Computed tomography (CT) is universally accepted as the diagnostic tool of choice for arterial injuries. However, selective angiography may be more useful as it provides accurate diagnosis and helps determine the therapeutic approach.[2]

Here, we report a rare case of blunt trauma of both the SCA and VA, which was successfully treated conservatively with observation.

CASE REPORT

A 21-year-old man was brought to our emergency department because of blunt trauma to both the right cervix and the right thoracic outlet during a motorcycle accident. On arrival, he had an extremely weak pulse in the right brachial artery and no detectable pulse in the right radial artery due to severe cervical hematoma. His vital signs were stable. There were no signs of circulatory dysfunction, such as cyanosis, or neurological dysfunction, such as paresthesia, or paresis of the right fingers, as collateral circulation maintained compensatory blood flow. The carotid artery pulse was normal and well-maintained.

Blood tests revealed no abnormal findings except mild leukocytosis and elevation in lactate dehydrogenase (LDH) and creatine phosphokinase (CPK) levels. Blood gas analysis findings were normal, except for the presence of a slight metabolic acidosis (Table 1).

Chest radiography revealed a widened superior mediastinum and right apical capping due to a substernal or extrapleural hematoma (Fig. 1A). CT angiography also confirmed stenosis of the right SCA, obstruction of the right VA, and apical capping (indicating right extrapleural hematoma) (Fig. 1B). Angiography with contrast media clearly showed stenosis of both the right SCA and the inferior thyroid artery, and right VA obstruction. Retrograde flow was observed from the left VA to the right

Table 1

BGA (5 L/min O_2 mask)	Blood cell counts	Serological data	Coagulation
pH 7.338 ↓	**WBC** 23,300 ↑ /mL	T-Bil 1.0 mg/dL	PT% 87.0%
$PaCO_2$ 41.9 mmHg	Neutro 68.1%	ALT 31 IU/L	PT-INR 1.05
PaO_2 185.2 mmHg	Lymph 27.1%	**LDH** 700 ↑ **IU/L**	APTT 25.2 sec
HCO_3^- 22.7 ↓ **mmol/L**	Others 4.8%	BUN 13 mg/dL	Fib 185 mg/dL
Lactate 18 ↑ **mg/dL**	RBC 4.64 x10^4 /mL	Crea 0.89 mg/dL	**FDP** 119 ↑ **mg/mL**
	Hb 16.1 g/dL	Na^+ 140 mEq/L	
	Hct 46.4%	K^+ 4.3 mEq/L	
	Plt 36.4 x10^4 /mL	Cl^- 106 mEq/L	
		CK 378 ↑ **mg/dL**	
		CRP < 0.3 mg/dL	

Abbreviations: **BGA**, Blood gas analysis; **HCO_3^-**, Bicarbonate ion; **WBC**, White blood cells; **Neutro**, Neutrophils; **Lymph**, Lymphocytes; **RBC**, Red blood cells; **Hb**, Hemoglobin; **Hct**, Hematocrit; **Plt**, Platelets; **T-Bil**, Total bilirubin; **ALT**, Alanine transaminase; **LDH**, Lactic dehydrogenase; **BUN**, Blood urea nitrogen, **Crea**, Creatinine; **Na^+**, Sodium ion; **K^+**, Potassium ion; **Cl^-** , Chloride ion; **CK**, Creatine phosphokinase; **CRP**, C-reactive protein; **PT%**, Prothrombin time%; **PT-INR**, Prothrombin time–international normalized ratio; **APTT**, Activated partial thromboplastin time; **Fib**, Fibrinogen; **FDP**, Fibrin degeneration products.

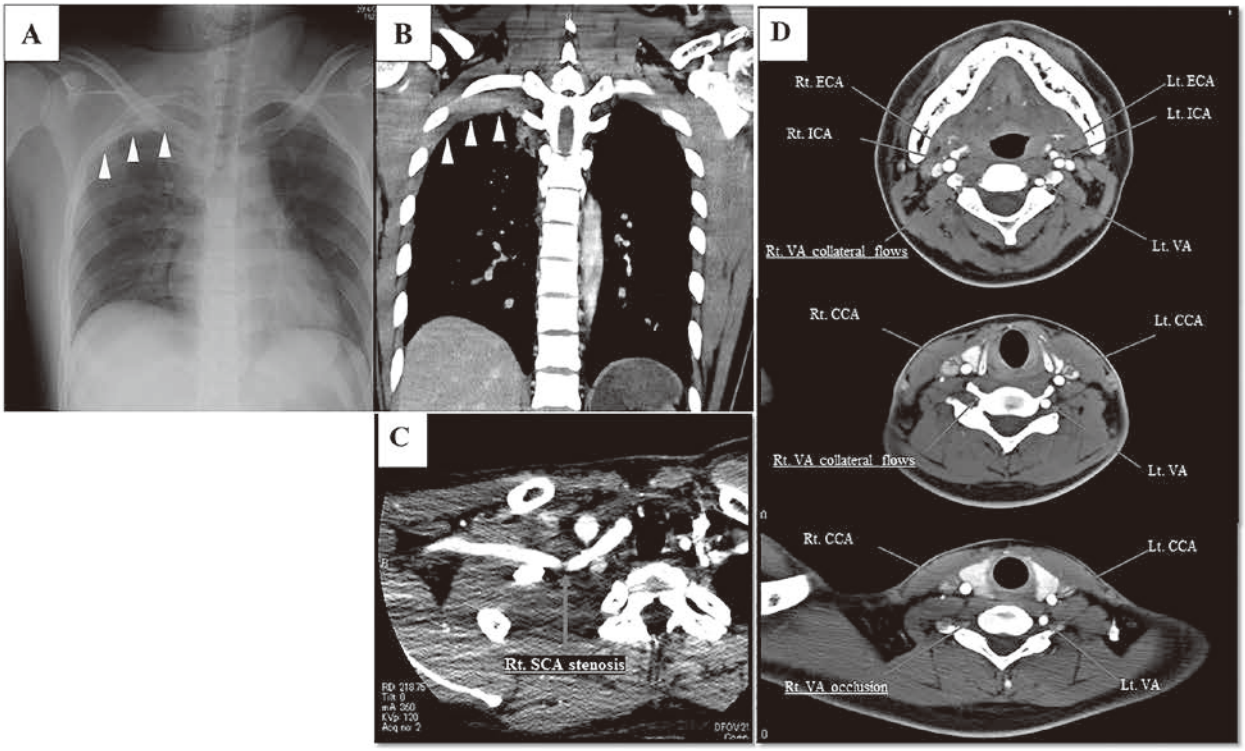

Figure 1.
Chest X-ray film [**A**] and computed tomography (CT) with contrast media performed in the emergency room show a widened superior mediastinum and right extrapleural apical capping due to a substernal or extrapleural hematoma (**A, B**, arrowheads). Helical CT scan with contrast media [**B–D**] shows severe stenosis of the right subclavian artery (SCA) (**C**, arrow). The right vertebral artery (VA) is completely occluded at the origin. However, the right peripheral VA is barely detected (**D**, arrows).
Abbreviations: CCA, common carotid artery; ECA, external carotid artery; ICA, internal carotid artery

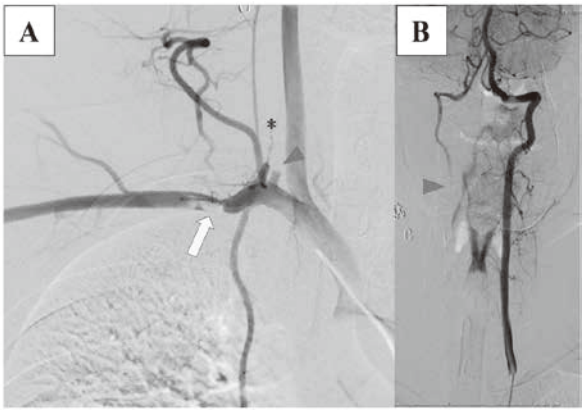

Figure 2.
Arteriogram of the brachiocephalic artery with contrast media clearly shows severe stenosis at the right subclavian artery (SCA) (arrow), at the right inferior thyroid artery (asterisk), and complete occlusion at the origin of the right vertebral artery (VA) (arrowhead) [**A**]. Arteriogram of the left VA with contrast media also shows retrograde flow to the right VA via the basilar artery (arrowhead) [**B**].

VA through the basilar artery (Fig. 2).

Anticoagulation therapy with heparin sodium (10,000 U/day) injection for 4 days was initiated to prevent arterial obstruction and cerebral infarction. The pulsation of the right radial artery recovered slowly with conservative therapy and could be detected 5 days after admission. The patient was discharged 27 days after admission. Neither ischemic symptoms of the right upper limb nor cerebral infarction occurred during admission or after discharge. Three months after discharge, follow-up CT, including CT angiography, was performed to examine the patency of the right SCA and VA. CT angiography showed remarkable improvement in the right SCA (Fig. 3), but the right VA remained occluded (Fig. 3). The patient successfully returned to his daily life without any vascular symptoms, to date.

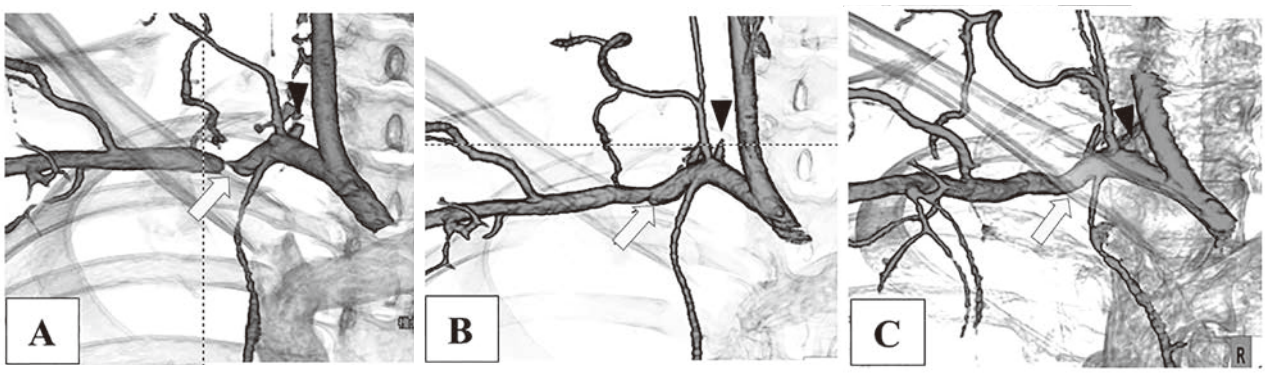

Figure 3.
Three-dimensional reconstructions from computed tomography arteriograms of the right subclavian artery (SCA) obtained at admission [**A**], 1 month later [**B**], and 3 months later [**C**] show dramatic improvement of blood flow in the right SCA (arrows); however, the right vertebral artery (VA) remains occluded 3 months later (arrowheads).

DISCUSSION

Blunt trauma to the SCA is relatively rare, accounting for approximately 1% of all arterial injuries because the SCA is well-protected by the clavicle and the first rib.[1, 5, 6] Surgical repair or intervention radiology, such as aortic stenting, is performed for patients with a poorer prognosis. Conservative therapy has been chosen in several rare cases.[7] Blunt injury to the VA, on the other hand, accounts for 0.5%～2.0% of all traumatic injuries and conservative therapy is chosen in most cases.[3]

Previous studies have compared endovascular surgery to open surgery and conservative therapy (observation alone).[5, 7] In the present case, the major reasons for selecting conservative therapy were as follows: (1) the wound site showed no external bleeding or pseudoaneurysm requiring surgical repair, (2) there was sufficient perfusion to the wound site in the right arm, and (3) there was no ischemic symptoms suggesting subclavian steal syndrome. These favorable conditions are probably attributable to the relatively low vascular risk factors associated with the patient's young age and the presence of relatively few atherosclerotic lesions.

Vascular stenting could have been associated with several complications, including stent restenosis and stent breakage. Additionally, the SCA is relatively mobile compared to other major arteries.[5] This, combined with the age and active lifestyle of the patient, could have made vascular stent stabilization difficult to achieve. Surgical repair is the last choice of therapeutic options because it requires a wide skin incision, such as the cervical extension of a median sternotomy. An SCA injury can involve intrathoracic, thoracic outlet, and/or cervical (so-called zone 1) lesions, and lesions of the axillary/upper extremities.[8] Therefore, we selected conservative therapy as the first line of treatment and achieved positive outcomes for the patient.

It is important to consider the risk of bleeding when performing anticoagulant therapy, especially in the case of trauma, wherein hemorrhage can be fatal. In this case, extrapleural hematoma from the right subclavian vein was evident; therefore, heparin injection was stopped 4 days after admission and anticoagulant treatment could not be restarted until the day of discharge.

Based on this experience, conservative therapy may be a therapeutic option for young patients with less arteriosclerotic burden and no SCA injury-related ischemic symptoms in the peripheral lesion, despite simultaneous injury to the SCA and VA. However, careful long-term follow-up is recommended because a pseudoaneurysm or thrombotic occlusion might occur after traumatic SCA injury.[8]

CONCLUSION

Here, we report a rare case of blunt trauma that injured both the right SCA and VA of a 21-year-old man, who was successfully treated with conservative therapy. In such cases, we recommend careful long-term follow-up as a pseudoaneurysm might develop after traumatic vascular injury.

INFORMED CONSENT

We have obtained the informed consent for submitting the clinical data to a medical journal from the patient and his family during admission.

CONFLICT OF INTEREST

There are no conflicts of interest to declare at the time of submission of this manuscript.

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鈍的外傷による右鎖骨下動脈・椎骨動脈複合損傷の一例

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要旨：【背景】鎖骨下動脈は解剖学的に鎖骨と第一肋骨により二重に覆われているため，鈍的外傷による血管損傷が起きにくい。今回，交通事故により右鎖骨下動脈と右椎骨動脈に複合損傷をきたした一例を経験したので報告する。【症例】21歳男性。主訴は右上肢の痺れ。バイク衝突事故で右橈骨動脈が触知不良のため，救急搬送された。初診時血圧は左上肢で140/110 mmHgと保たれていたが，右橈骨動脈の拍動は極めて微弱であった。右鎖骨と右肋骨に骨折はなく，造影CTで右鎖骨下動脈の狭窄を認め，血管造影を施行したところ，右鎖骨下動脈に内膜損傷による高度な狭窄と，右椎骨動脈に血流の途絶を認めた。病変部より末梢は，右鎖骨下動脈では側副路により順行性に，右椎骨動脈では脳底動脈を介して左椎骨動脈より逆行性に，それぞれ血流が保たれていた。治療は止血目的で一時的に抗凝固薬を中止して保存的治療としたが，入院期間中に脳梗塞や右上肢血行障害等は認めなかった。受傷27日の3D-CTで右鎖骨下動脈の狭窄が改善し，右橈骨動脈の拍動も回復したため，抗凝固薬を再開して退院した。受傷３か月後の3D-CTでは右鎖骨下動脈の狭窄はほぼ完全に消失していた。【考察】鈍的外傷による鎖骨下動脈損傷は全動脈損傷の１％と非常に稀である。本症例の様に患者が若年で動脈硬化がなく，病変部より末梢の血流が側副路を介して保たれている場合には，保存的治療も選択肢の一つである。今後，仮性動脈瘤の形成に注意しつつ長期のフォローアップが重要であると思われる。

索引用語：　鈍的血管外傷　／　血管造影　／　胸郭出口　／　鈍的頸部外傷

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