Case report

Giant delayed pseudo-aneurysm following screw placement in C1 lateral mass

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1. Introduction

Iatrogenic vertebral artery injury (VAI) is a rare complication of cervical spine surgery [1]. It can happen in the anterior cervical procedures or posterior spine surgeries. The reported rates of VA injury range from 0.3 to 8.2% [1–3] according to the different instrumentational techniques. As with the application of new surgical techniques more popularly, such as C1 lateral mass screw or cervical pedicle screw the risk of VAI raised correspondingly. The greatest danger occurs during drilling, tapping, and insertion of screws [4,5] because the trajectory is not visible during these procedures.

VAI can lead to catastrophic consequences such as massive bleeding, pseudoaneurysm [2], cerebellar or brain stem infarction [6], even mortality [7]. The management in operation and subsequent complication disposal of VAI is demanding and controversial. The reported rates of VA injury in cervical spine surgery are variable depending on the different techniques used. This article provided one case with severe late complication who suffered iatrogenic VAI during C1 lateral mass screw placement. And the literatures on VAI were also reviewed. The management and precautionary measures were discussed.

2. Case report

A 43-year-old woman was involved in a traffic accident and admitted to a local hospital. She was neurologically intact. The lateral radiograph view of cervical spine showed bilateral C2 pars fractures (Fig. 1). According to local hospital medical records, she was scheduled for posterior atlantoaxial fusion using a screw-rod construct for the early rehabilitation. In accordance with the surgical records, during drilling into the right C1 lateral mass, the vertebral artery at VA groove was injured for the sliding of drill, causing massive arterial bleeding. Temporary control of the bleeding was achieved by gauze tamponade. However, bleeding recurred once the packing was removed. Due to ensuing hemorrhagic shock and difficult visualization of the surgical field, fixation and surgery was aborted at 2.5 hours of operative time with the wound packed. Several days later, the wound was reopened and the packed gauze was removed and further attempt to instrumentation was abandoned. The patient was immobilized by rigid cervical collar and no new neurologic deficit was observed. Postoperative magnetic resonance angiography or conventional angiography was not performed and she was discharged home. One year later, the patient sought medical help at our institute for a gradually increasing neck mass. CTA with 16-slice spiral CT and MR images of the cervical spine was ordered for evaluation of the neck mass. The CTA demonstrated a pseudoaneurysm of more than 7 cm in size originating from the level of C1 and extending caudally to C6 and posteriorly to the subfascial level (Fig. 2A, B, C). The intracranial portion of the affected vertebral artery was obviously smaller than the contratetral artery (Fig. 2A, B). Cervical MR images revealed laminating changes within the pseudoaneurysm with high-low intensity.
signals on T1 images and mixed high signal intensities on T2 images (Fig. 2D, E), indicating that there were thrombosis outside and the blood flow inside of the pseudoaneurysm. The patient was afraid of the risk of further surgical attempts and refused the endovascular therapy to the mass. Up to now, it has been for more than three years regular follow-up, she maintained the intact neurologic status and acquired a good fusion.

3. Discussion

3.1. Factors of IVAI

IVAÏ is usually attributed to several factors: an anterior extensive lateral procedure such as decompression of the uncovertebral joints, lateral disc removal, or intraoperative loss of a midline landmark, misplacement of the instruments, bone pathologically erosion by tumor, infection and so on.

Posterior C1-2 transarticular screw fixation is one of the main causes for iatrogenic VAI accounting for 0 to 8.2% of VAI [8]. In comparison, C1 lateral mass screw fixation is suggested to be a less demanding technique with a lower risk of vertebral artery injury than C1-2 transarticular fixation. Nevertheless, it has been reported that vertebral artery may be injured due to tap deviation superiorly on the C1 lateral mass [2]. It was also the cause for the intraoperative massive bleeding in this case in accordance with the description of the medical record. Cervical pedicle screw fixation is another cause for iatrogenic VAI. Pedicle screws may offer greater stability compared with lateral mass screws or spinous process wiring, but have a greater risk of VA injury. The cervical pedicle is thinnest (especially C4) laterally toward the VA, during screw insertion care must be taken not to penetrate the lateral wall. Unlike unilateral VA occlusion in which only 20% of patients were symptomatic [9], most patients with bilateral VA occlusion after cervical spine trauma are symptomatic including quadriplegia [10], stroke or death. Few patients that did not have any symptoms related to the bilateral VA occlusion were reported, possibly due to adequate collateral supply from the posterior communicating arteries. To the authors’ knowledge, there has been no literature reported on the bilateral VAI after cervical pedicle screw fixation.

3.2. Management of Iatrogenic VAI

The management of iatrogenic VA injury is still controversial. First how to control the sudden, copious bright red hemorrhage is of technique and patience demanding. There are usually two types of bleeding after VAI: bleeding in screw hole and bleeding in the open space. The former was not massive and can be well controlled by bone wax and screw insertion. Therefore, screw insertion may be the most practical method of hemostasis. On the contrary, VAI in the open space can cause massive bleeding; it is difficult or impossible to identify the bleeding point. Direct blind tamponade with hemostatic agents, such as gelfoam surgicel or bone wax can temporarily control the bleeding, but massive bleeding would encountered again once the packing agent was removed. Also, delayed hemorrhage and fistula or pseudoaneurysm formation have been reported [2]. Primary vascular repair will restore normal blood flow, but is technically demanding. Ligation of the VA is another choice. However, it should remember that unilateral VA ligation may cause catastrophic consequence if the contralateral VA does not supply adequate blood flow to the brain. Intraoperative angiography should be considered to define the lesion and to confirm adequate collateral circulation to the brain. Balloon occlusion test may be beneficial to decide if the collateral circulation is limited anatomically or compromised by vasospasm [11]. The vessel should be ligated proximally and distally to minimize the risk of delayed hemorrhagic complications or fistula formation. If VA damage is suspected during placement of the first screw, no attempt should be made to place the contralateral screw to avoid severe complications caused bilateral VA injury [12]. Alternative surgical strategy such as laminar screw or halo vest can be considered.

The postoperative management is still discrepancy. Some recommend close observation after controlling bleeding intraoperatively to determine the further intervention, whereas others advocate immediate postoperative angiography, because recurrent hemorrhage, distal embolization, or infarction may happen at a later date [13]. We are in favor the latter. It should remember that even a normal angiography can not rule out later pseudoaneurysm formation [14] and magnetic resonance angiography or computer tomography (CT) angiography should be followed up to exclude the late complication. Recently, endovascular therapy, such as microcoils or balloons occlusion or stent placement also provide a good alternative during the angiography. Because it can avoid the manipulation of the tissues adjacent to the target vessel, decreasing the risk of damage due to retraction or resection. In a study by Kashiwazaki et al., endovascular internal trapping for VAI is a therapy with satisfactory long-term outcomes [15]. Endovascular therapy may be better for the early detecting case. As for this case with late complication in our paper, we have not seen the analogical reports. The pseudoaneurysm is so big that, we think it is obviously not suitable for endovascular therapy.

3.3. Prevention of IVAI

Prevention is the best treatment for iatrogenic injury. Preoperative evaluation of the VA is important to avoid IVAI and neurologic sequelae. Therefore, we recommend that all the preoperative imaging should be carefully reviewed, especially for the CT angiography or magnetic resonance angiography. The position of VA and its relationship with surrounding structure should be observed. 3-D reconstruction of CT angiography can delineate the spatial anatomy. We also can get the information of dimensions of pedicles or lateral masses and determine the safe trajectory for screw placement. If VAI is suspected in operation, postoperative VA evaluation is also important to detect the complications such as...
arteriovenous fistulas, pseudoaneurysm and thrombosis as early as possible [16].

4. Conclusions

Catastrophic VAI complications do occur in the surgical treatment during the posterior approach. Preoperative careful evaluation of the vertebral artery in regards to the pedicle anatomy seems to be important to avoid the iatrogenic VAI. If intraoperative massive bleeding occurs, initial control can be obtained by hemostatic packing or screw insertion. However, there is a risk of delayed pseudoaneurysm formation in this case, so intraoperative or postoperative vertebral angiography should be performed. Prompt recognition and correct management is indicated for these complications.

Disclosure of interest

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References


