Anomalous Vertebral Artery: A Cadaveric and Clinical Case Study
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INTRODUCTION: Anterior cervical decompression by subtotal corpectomy
combined with fusion is a well-accepted treatment for cervical spondylotic
myelopathy or radioculopathy. Injury to the vertebral artery during the phase of
decompression is a rare complication with potentially catastrophic consequences.
Well-accepted surgical intraoperative landmarks are often used to define the
lateral extent of corpectomy. However, the presence of an abnormally tortuous
vertebral artery with migration towards midline has been well documented in the
literature. Lack of recognition preoperatively of this anomaly can lead to
laceration of the vessel even by decompression within generally accepted safe
limits. The incidence of this anomaly within the general population as well as
its characteristics are not known.

MATERIALS AND METHODS: 3 patients with an ectopic vertebral artery
undergoing anterior cervical corpectomy within the last 2 years were identified at
our institution. This prompted us to perform a study on 123 consecutive
cadaveric adult subaxial cervical specimens of C3-C6 (total 492 vertebral levels)
from the Todd-Hamman Collection at the Cleveland Museum of Natural
History. The sex and age of each specimen was recorded. A digital high
precision caliper with customized tips was used to measure the distances
between the uncovertebral joints (UVJ) at each level. Also the distance between
the UVJ and the medial aspect of the vertebral foramen on each side was
measured. Next an additional 99 (giving a total of 222) adult specimens (total
888 vertebral levels) were subjected to visual inspection only. From the entire
group specimens with frank ectasia of the vertebral artery into the vertebral body
were selected. The selected specimens were evaluated by axial CT scanning. A
radiographic marker at the level of the vertebral artery marked the location of the
UVJ. The distance from the UVJ (visualized by a marker) to the most medial
aspect of the vertebral foramen was then measured directly off the axial
CT scan. The distance (recorded in mm) was given a negative value if the
medial aspect of this foramen was medial to the radiographic marker, and a
positive value if it was lateral.

RESULTS: 7 vertebrae (6 out of 222 cadaveric specimens or 2.7%) were
identified as having an ectopic vertebral artery. There were three abnormal C3
vertebrae, three C4 vertebrae and one anomalous C6 (one cadaver had an
abnormal C3 and C6). All anomalies were unilateral. The mean distance from
the UVJ to medial aspect of vertebral foramen as measured by CT in the abnormal vertebrae was -0.14mm +/- 1.19 (range: -2.0 to +1.5).

The mean UVJ to vertebral foramen distance was on the right +5.4mm +/-2.7 (range: -0.75 to +14.0) and on the left +5.7mm +/-2.2 (range: -2.0 to +14.9). This was not statistically significant (paired T-test). The mean inter-UVJ distance was 26.8mm +/-2.6 (range: 20.2 to 35.8). The mean UVJ to vertebral foramen distance for each level were as follows - C3: +5.3mm, C4: +5.1mm, C5: +5.3mm, C6: +5.15mm. The differences were not statistically significant (ANOVA p=0.73).

The first case of ectasia was identified intraoperatively when a laceration of the vertebral artery occurred during the initial stage of a motorized corpectomy. The laceration was repaired and the 3 level anterior cervical corpectomy and fusion (ACCF) was completed in a standard fashion. The patient healed without neurologic sequelae. The next two cases were identified preoperatively. Both patients instead of undergoing a standard 3 level ACCF were managed by a 2 level ACCF combined with a wide cervical discectomy and fusion (ACDF) adjacent to the anomalous segment. The intraoperative course, as well as postoperative healing was uneventful in both cases.

DISCUSSION: Tortuosity of the vertebral artery is a well-recognized phenomenon. Lack of preoperative recognition of this problem can result in serious complications. The UVJ or joint of Luschka provides usually a safe margin for the lateral extent of decompression with an average of 5 mm of bone remaining to the vertebral foramen. This 5mm average distance between the medial aspect of UVJ and the medial aspect of the vertebral foramen in our study is in concordance with the literature. However, in 2.7% of patients in our study the vertebral artery was located medial to UVJ or less than 1.5mm lateral to UVJ. The UVJ is usually located superior to the ectopic vertebral foramen. Therefore the two structures are not visible on a single axial CT cut and their relation can be difficult to assess preoperatively. Therefore the UVJ is even less reliable during preoperative planning. In the face of an abnormally tortuous vertebral artery, with ectasia into the vertebral body, other levels of the cervical spine must be carefully inspected since this anomaly can be present at multiple levels (1/6 anomalous cases in our study) with special attention to C3 and C4, since most anomalies were located at these levels. The treatment protocol must be appropriately altered. In 2 of our patients the cervical pathology was successfully managed by anterior decompression by combining a wide ACDF at the abnormal level with standard decompression at other normal levels, but a posterior decompression with laminoplasty has been reportedly used with success in the literature.
CONCLUSIONS: The incidence of abnormally ectopic vertebral artery in the general population is low but significant. Most anomalies are located in the upper cervical subaxial vertebrae. Even though rare, vertebral art. ectasia can occur at multiple levels simultaneously. In patients with ectasia the UVJ is not a safe anatomic landmark of the lateral extent of the decompression. Preoperative recognition of the anomaly is key to avoiding vascular complications. Treatment by wide discectomy and fusion above and below the anomalous vertebrae, instead of a corpectomy, and combining this with a standard ACCF can give an excellent clinical result without risking significant complications.

REFERENCES: