

The Risk Factors Related To Neurologic Safety during One-stage Posterior Vertebral Column Resection for Patients with Severe and Rigid Spinal Deformities



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Conflict of interest disclosure

- No interest disclosure included in any author of this research



Background

- PVCR procedures have shown that the technique has achieved significant deformity correction and overall balance as compared with conventional correction techniques.
- However, PVCR procedures are plagued with high complication rate of 39% on average, and the incidence of neurologic complications is more common than in other posterior correction techniques.
- **To investigate** what factors have impacts on neurologic complications and how to reduce the incidence of neurologic complications.



Methods

- A consecutive series of 76 patients treated with PVCR at a single institution between October 2004 and July 2011 were included in our study.

- **Study group** :Six patients with changes in neurological functions.

Control group: the remaining 70 patients.

- **10** variables that might affect the safety of spinal cord during PVCR procedures were analyzed using **univariate analysis**.
- The variables that were statistically different between the study group and the control group were further analyzed using **multi-factor unconditional logistic regression analysis** to identify the risk factors affecting the safety of the spinal cord during PVCR procedures.

Methods-Variables

- **The general information** : gender , age, etiology , Preoperative neurologic dysfunction , whether the patients were associated with increased spinal cord tension (i.e, Chiari malformation, syringomyelia or tethered spinal cord)
- **Radiographic factors:** apex of the main curve , Cobb angle at the main curve at the coronal plane , scoliosis associated with kyphosis
- **Surgical factors** : levels of vertebral column resected intraoperatively , number of sectional vessels ligated off intraoperatively.



Results- Single-factor comparison

- Location of apical vertebra at the main curve
- Cobb angle of the main curve at the coronal plane
- Scoliosis associated with kyphosis
- Levels of vertebrae resected
- Number of sectional vessels ligated off
- Preexisting neurologic dysfunction
- Pathology associated with increased spinal cord tension



Results - Multi-factor comparison

Variables	B	S.E.	Wald	OR	95% C.I. for EXP(B)	
					Lower	Upper
Preoperative neurologic dysfunction	3.898	1.363	8.180	49.322	3.410	713.320
spinal deformity with pathology that increases the spinal cord tension	2.914	1.281	5.172	18.423	1.496	226.904
scoliosis associated with kyphosis	2.475	1.146	4.662	11.883	1.256	112.392
levels of vertebrae resected	2.171	0.919	5.583	8.769	1.448	53.109
Coefficient	-12.139	3.510	11.961	0.000		

Discussion- mechanisms

Mechanisms : 2 phases of PVCR procedures

- **The phase of vertebral column resection**
 - pedicle screw insertion
 - Ligation of sectional
 - Vertebral column resection
 - Spinal cord ischemia-reperfusion injury following vertebral column resection
- **The phase of correction processes following vertebral column resection**
 - spine translation
 - rotation
 - angulation
 - over-shortening

Discussion- Risk factors of neurologic complications

Clinical factors

- **Preoperative neurologic dysfunction** was the most significant factor affected the safety of the spinal cord and an independent risk factor for the injury of the nervous system of the patients with severe spinal deformities during PVCR procedures.
- **Scoliosis associated with pathology that increased the spinal cord tension** (i.e. **Chiari malformation, syringomyelia or tethered cord**) was an independent risk factor affecting the safety of the spinal cord.

Discussion- Risk factors of neurologic complications

Medical imaging factors

- **Severe spinal deformities associated with kyphosis** was an independent risk factor for the injury of the nervous system in patients with severe spinal deformities during PVCR procedures.



Discussion- Risk factors of neurologic complications

Operational factors

- **Level of vertebrae resected** was an independent risk factor for the injury of the nervous system in patients with severe spinal deformities during PVCR procedures.
- **Level of vertebrae resected and number of sectional vessels ligated** was correlated.

Conclusion

- The risks of neurologic complications mainly occurred at two phases of PVCR procedures: (1) the phase of vertebral column resection, and (2) the phase of correction processes following vertebral column resection.
- Preexisting neurologic dysfunction, pathology with increased spinal cord tension, scoliosis associated with kyphosis and levels of vertebrae resected were independent risk factors affecting the safety of the spinal cord.
- The crucial method to prevent the spinal cord injury intraoperatively was to make sure that the spinal cord tension was not higher than before surgery and that the spine and the spinal cord did not over tether due to shortening of the spine.
- Intraoperative monitoring of neurologic function was necessary and wake-up test was reliable on predicting the spinal cord injury.