Mechanical failure and related factors following total en bloc spondylectomy

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INTRODUCTION:

Total en bloc spondylectomy (TES) was developed to achieve complete oncological resection of spinal tumors. This procedure has provided an excellent local control and long-term survival after TES has been reported. Therefore, spinal reconstruction in TES is getting more important for long-term function. Although the incidence of instrumentation failure (IF) after TES is high, there have been only a few studies with small sample size focusing on instrumentation-related issues. The purpose of this study was to investigate the features and risk factors of IF after TES.

METHODS:

From 2001 to 2015, 223 consecutive patients with primary or metastatic spinal tumors underwent TES at our institution. Their data were retrospectively reviewed for the current study. The exclusion criteria were as follows: 1) followed up less than 36 months after TES; 2) developed surgical site infection or cerebrospinal fluid leakage after TES; 3) non-ambulatory status at final follow-up.

Spinal reconstruction after tumor resection was performed using anterior structural support and posterior instrumentation. Anterior spinal reconstruction was performed using a titanium mesh cage filled with autograft harvested from the iliac crest or frozen tumor-bearing vertebra treated with liquid nitrogen (frozen autograft). Posterior instrumentation was performed with two-above and two-below segmental fixation using pedicle screws, titanium alloy rods, and two transverse connectors.

The primary outcome measure was incidence of IF, which was defined as instrument breakage requiring revision surgery due to pain or neurologic disability. Patients' data including age, sex, BMI, history of perioperative chemotherapy and radiotherapy, tumor histology were obtained from the electronic medical records. Surgery-related data including approach, location of resected tumor, number of resected vertebrae, resection, and type of bone were gathered from operative records.

Local alignment (LA) and cage subsidence were evaluated as radiographic parameters. Preoperative LA was defined as lordosis of scheduled instrumented level on preoperative radiograph and postoperative LA was defined as lordosis of instrumented level on postoperative radiograph. ΔLA was calculated by subtracting preoperative LA from postoperative LA. Cage subsidence at 1 month post-operation (CS1M) was measured from pre- and postoperative radiographs (Fig. 1). Patients who developed IF underwent computed tomography (CT) scans in addition to radiographs.

A survival analysis of the instrumentation was conducted using Kaplan-Meier method. The student's t test and chi-square test were used for univariate analysis. The relationship between IF and related factors were investigated using Cox proportional hazards multivariate model and results are presented as hazard ratios (HR) with 95% confidence intervals (CI). P-value of <0.05 was considered as statistically significant throughout.

RESULTS:

After implementing the exclusion criteria, 136 patients were included in the present study. The population included 71 men and 65 women with a mean age of 53 ±14 years, and mean follow-up period of 101 ± 47 months.

IF occurred in 44 cases (32%) including 38 rod fracture, 3 screw fracture and 3 screw cut out. The median time to IF was 32 months (IQR, 23–74 months) after TES and estimated IF-free survival rates were 76% at 5 years and 57% at 10 years (fig.2). Radiographs taken immediately before IF showed 6.0 ± 3.9 mm cage subsidence and 11 ± 7.5° kyphosis enhancement of the LA (Fig. 3). CT performed at the time of IF showed radiolucent area between the cage and endplate in all cases. Comparison of IF developing group (IF group) and non-developing group (control group) showed greater BMI and CS1M, and more frozen autograft without autograft in the IF group (Table 1). Cox proportional hazards analysis showed TES at the lumbar level (HR = 2.0; 95% CI, 1.1–3.9), multi-level TES (HR = 2.1; 95% CI, 1.1–4.1), CS1M ≥ 3 mm (HR = 3.4; 95% CI, 1.7–6.7), and frozen autograft without autograft (HR = 2.7; 95% CI, 1.4–5.2) as independent risk factors for the incidence of IF.

DISCUSSION AND CONCLUSION:

Most of the IF after TES was rod fracture following local kyphosis caused by sinking of the cage. TES at lumbar level, multi-level TES, early postoperative cage subsidence and frozen graft alone were significant risk factors related to IF after TES. More robust spinal reconstruction to avoid cage subsidence and high-quality bone grafting to obtain solid osseous fusion should be considered when planning TES.