Research on the predicting power of the revised Tokuhashi system – how much time can give surgery to short life expectancy patients? Analysis of 329 patients

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INTRODUCTION

The spine is the third most common metastatic site of our body after the liver and lung. The secondary lesions may affect nearly 70% of tumorous patients. The ever-expanding oncological treatment opportunities extend the lifetime of the patients, and, consequently they affect the incidence of secondary lesions.

Primary treatment option for metastatic spine tumor is surgery (supplemented by radiotherapy in accordance with the radiosensitivity of the primary alteration). The exact surgical methodology (posterior stabilization with or without decompression, debulking, partial or en bloc spondylectomy etc.) depends on the general conditions of the individual.

Modern medicine requires the implementation of personalized solutions, in which the prognostic predicting scoring systems could help us. The “revised Tokuhashi system” (rTS) perhaps is the most well-known system worldwide, however, the publications discussing its usability are also highly controversial.

Table 1: revised Tokuhashi system

We have previously tested the factors that have the most significant impact on survival [1]. Later, we published about the efficiency and prediction accuracy of the four best-known scoring systems used with metastatic spinal tumor patients. The systems are able to separate the patients according to their overall survival periods. However, the rTS showed 60.5%, Tomita 28.8%, modified Bauer 29.5% and the van der Linden 48.6% precision about the prediction of the real survival periods [2].

Our aim was to present a plausible explanation of why the rTS has low precision despite of its statistically validated separation feasibility.
We have made a retrospective study from the data of metastatic vertebral patients who underwent surgery between 2008-2015 in the National Institute of Clinical Neurosciences, Budapest.

The statistical data analysis (Kaplan-Meier analysis, Log-rank test, Fischer’s exact test) was made by the MTA-ELTE Statistical and Biological Physics Research Group.

There are 384 operations and 329 cases in our database.
RESULTS

Our previous results:

Figure and Table 1: KM curve of the revised Tokuhashi system and the Consistency rates for the categories:

- "Conservative" category: p<1e-6
- "Palliative" category: p=0.00013
- "Excisional" category: p=0.013
- Consistency rate: 60.5%

First step:
The rTS establishes three prognostic categories. We tested each of them for survival prediction: are the prognoses of survival rates in concert with the findings in the population of the data set of our study?

In our population, the OS value decreased to 0.15 on day 475 (CI 95% 359–796) (contrary to the 180th day in the literature). However, it is worthy of note that in the original Tokuhashi study, the prognostic values were calculated with patients who only received conservative treatment and did not undergo surgery. In our database, we have no data of patients who received this type of therapy only, every patient had surgical therapy.

### Table 2: Survival rates at typical time points for rTokuhashi prognostic values, “conservative category”

<table>
<thead>
<tr>
<th>Time (days)</th>
<th>OS</th>
<th>Std.error</th>
<th>Lower 95.00% CI</th>
<th>Upper 95.00% CI</th>
<th>Literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>0.8623</td>
<td>0.0293</td>
<td>0.8067</td>
<td>0.922</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>0.7319</td>
<td>0.0377</td>
<td>0.6616</td>
<td>0.81</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>0.6449</td>
<td>0.0407</td>
<td>0.5698</td>
<td>0.73</td>
<td></td>
</tr>
<tr>
<td>180</td>
<td>0.38</td>
<td>0.0416</td>
<td>0.3066</td>
<td>0.471</td>
<td>0.15 = We have higher survival</td>
</tr>
</tbody>
</table>

Conservative category

<table>
<thead>
<tr>
<th>Category</th>
<th>Predicted survival time</th>
<th>Case number (n)</th>
<th>Konzisztencia rata</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservative (0-8p)</td>
<td>&lt; 180 nap</td>
<td>132</td>
<td>0.62 (95%CI: 0.529-0.693)</td>
</tr>
<tr>
<td>Palliative (9-11p)</td>
<td>&gt; 180 nap</td>
<td>125</td>
<td>0.653 (95%CI: 0.575-0.741)</td>
</tr>
<tr>
<td>Excisional (12-15p)</td>
<td>&gt; 365 nap</td>
<td>63</td>
<td>0.541 (95%CI: 0.422-0.693)</td>
</tr>
</tbody>
</table>
RESULTS

**Second step:** Proposing a new maximum score for conservative treatment.

![Graph showing p-values vs revised Tokuhashi score for the conservative category](image1)

**Figure 2:** p values of the log-rank test for the difference between Kaplan–Meier survival of the conservative group, when the “score limit” is the upper revised Tokuhashi score value for the conservative group.

![Graph showing Kaplan-Meier curves for the conservative category](image2)

**Figure 3:** Kaplan-Meier curves of the conservative category.

We can observe, that the OS difference (measured by the p value of the log-rank test) does not change, when the cutoff score between the conservative and palliative category changes from 8 to 7, but at the cutoff score 6 we see rapid change in the significance level.
### Results

**Last step:** Is the prolongation of the survival time associated with an improved quality of life?

<table>
<thead>
<tr>
<th></th>
<th>Symptoms in total</th>
<th>Success rate (%)</th>
<th>Pain</th>
<th>Success rate (%)</th>
<th>Motorial dysfunction</th>
<th>Success rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Improve (case no.)</td>
<td>Decrease (case no.)</td>
<td>Improve (case no.)</td>
<td>Decrease (case no.)</td>
<td>Improve (case no.)</td>
<td>Decrease (case no.)</td>
</tr>
<tr>
<td>Longer-survival subgroup (n=48)</td>
<td>47</td>
<td>1</td>
<td>98</td>
<td>42</td>
<td>6</td>
<td>88</td>
</tr>
<tr>
<td>Shorter-survival subgroup (n=84)</td>
<td>83</td>
<td>1</td>
<td>99</td>
<td>80</td>
<td>4</td>
<td>95</td>
</tr>
</tbody>
</table>

**Figure 3:** Solution of symptoms in the two subgroups of the conservative category

- $p<1 \times 10^{-5}$
- $p=1$
1. Prognosis-predicting systems could help, however, but we would like to emphasize that they only serve as guidance and are of secondary importance compared to a doctor’s years or decades of medical experience.

2. According to our results, rTS draws a too strict boundary between surgical and other, non-surgical palliative and/or supportive therapeutic options.

3. It may be worthwhile to also provide surgery for patients who are in poor condition based on the scoring systems.

4. Surgical treatment is unquestionably important for the treatment of pain and may also lead to further improvement in the quality of life of a patient through the improvement/preservation of neurological functions, which may make patients eligible for further oncological treatments.

5. We believe our results could be a possible base of multicentric prospective study in the future and a prospective study was started.
REFERENCES:


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