Fall risk Assessment of Stroke Patients in a Rehabilitation Ward after Hospital Discharge: A Prospective Cohort Study

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INTRODUCTION AND AIMS
Fall risk among stroke survivors is significantly higher than among age-matched controls [1]. The specific fall incidence among stroke patients in acute care ranges from 14% to 64.5% and, in the rehabilitation setting, from 24% to 47% [2]. Research studies reveal a high incidence of post stroke falls after discharge from inpatient rehabilitation: from 23% to 34% in the first 3-4 months, 40% to 70% in the first 6 months and from 43% to 70% in a 1 year follow up [3].

Patients who are at risk for falls within the rehabilitation setting can be identified by using a variety of impairment and functional assessments [2]. Instrumenting already existing and widely used functional tests by means of wearable inertial sensors is it possible to provide automatic algorithms for an objective and comprehensive assessment which goes well beyond the pure motor function measures.

The aim of the study is to: (i) predict fall risk of stroke patients after hospital discharge by means of clinically validated tools and sensor-based assessment tools; and (ii) to define an objective functional profile of the patient for developing personalised prevention strategies, comparing pharmacological and rehabilitation treatments, and for the patient follow-up.

RESULTS AND IMPACT
Instrumental parameter risk factors for falls:
CST: A high value for the Jerk Score, which is associated with a low movement smoothness, in the anterior-posterior direction for both sit-to-stand and stand-to-sit postural transitions is a risk factor.

SBT: A high postural sway frequency in the medio-lateral direction measured in quiet standing conditions with feet apart is a risk factor.

Instrumental parameter protective factors for falls:
FRT: A high angular velocity range about the medio-lateral axis during the trunk flexion and a high peak value of the angular velocity about the medio-lateral axis during the trunk extension are protective factors.

NEXT STEPS / SUSTAINABILITY
The next steps are the completion of the recruitment of the patients and the data analysis. The idea of instrumenting already existing and widely used functional tests makes the sensor-based assessment an integral part of the clinical assessment. The sensor is easy to use, cheap, and manageable by means of a modern mobile without the need of having additional dedicated personnel. This means that the approach is scalable and sustainable.

INNOVATION
The sensor-based assessment is a well standardised and objective approach providing in-depth evaluation of the patient motor function and potentially allowing to identify sub-clinical signs of motor impairment.

CONCLUSION
Preliminary evidence suggests that a sensor-based assessment integrated into the clinical practice can be a valid and low-cost solution for quantitative movement assessment with a clear clinical value. An objective functional profile of stroke patients would allow developing personalised interventions for fall risk reduction.

METHODS
40 stroke patients (out of 290 expected by the end of the study), who completed the 12 months telephone follow-up after the discharge, were examined in this study. The subjects were recruited in the Medicina Fisica Riabilitativa and Stroke-Unit of the Bologna AOU. The inertial sensor was worn on the lower back at the level of the fifth lumbar vertebra. Instrumented functional tests include:
- 10 Meters Walking Test (10MWT)
- Time Up and Go Test (TUGT)
- Repeated Chair Standing (RCS)
- Standing Balance Test (SBT)
- Functional Reaching Test (FRT)

Reported results are limited to the RCS, SBT, and FRT.

<table>
<thead>
<tr>
<th>TEST</th>
<th>INSTRUMENTAL PARAMETER</th>
<th>Incidence Rate Ratio (IRR)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CST</td>
<td>Sit-to-Stand Jerk Score in the Anterior-Posterior direction</td>
<td>2.24</td>
<td>0.01</td>
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<tr>
<td></td>
<td>Stand-to-Sit Jerk Score in the Anterior-Posterior direction</td>
<td>1.91</td>
<td>0.01</td>
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<tr>
<td>SBT</td>
<td>Medio-lateral postural sway frequency with feet apart</td>
<td>1.96</td>
<td>0.006</td>
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<tr>
<td>FRT</td>
<td>Range of the angular velocity about the medio-lateral axis</td>
<td>0.52</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>Angular velocity peak about the medio-lateral axis</td>
<td>0.49</td>
<td>0.02</td>
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</tbody>
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