Introduction

• RECIST widely used in oncology clinical trials to evaluate response to treatment
• Endpoints of RECIST have been used as primary or supportive data for regulatory approvals
• Provides standardized set of rules based on imaging modalities
• Measurable vs. Non-measurable (evaluable) disease dilemma at baseline
When to use RECIST 1.1

- All solid tumors
- Exceptions:
  - Lymphoma
  - GIST during Glivec therapy
  - HCC
  - Malignant brain tumors

Basics of RECIST 1.1- Method of Assessment

- ✔️ Computerized Tomography (with IV contrast, 5 mm or thinner slices)
- ✔️ Magnetic Resonance Imaging
- ✔️ Chest X-ray
- ✗ Ultrasound

- Endoscopy and Laparoscopy
- PET/CT
Basics of RECIST 1.1- Tumor Measurements

Basics of RECIST 1.1- Baseline

• Choose “target lesions”

  **Tumours**
  - CT scan: long axis > 10mm
  - Chest X-ray: long axis > 20mm

  **Malignant lymph nodes**
  - Short axis diameter > 15mm
Basics of RECIST 1.1- Baseline

Selection of lesions
Choose 1 to 5 target lesions, equally distributed over affected organs (with a maximum of 2 per organ)
Preferably choose largest lesions
Preferably choose well-described lesions that are easy to measure

Basics of RECIST 1.1- Baseline

• Identify “non-target lesions”
  • All small lesions (not matching criteria for target lesion)
  • Non measurable lesions: pleural effusion, ascites, leptomeningeal disease, lymphangitic involvement of lung
  • Lesions with radiotherapy
  • Bone lesions without soft tissue component
Examples of Non-Target Lesions

Basics of RECIST 1.1- Baseline

- Calculate “sum of the diameters”
Example Case: Head and Neck Cancer, Outside Scan

Miliary Lung Lesions (non-measurable)  Liver Lesion (Target 1)

77 yo male. Bladder cancer, cystoprostatectomy

Pick-up Target lesions: 3 Target lesions

Target lesion #1, Left Periaortic LAP, SAD
Target lesion #2, Right External Iliac LAP, SAD
Target lesion #3, Left Pelvic Lesion, LAD

Sum of the Diameters: 3.4+2.7+4.2= 10.3 cm
Non Target lesions

Basics of RECIST 1.1 - Follow-up

- Identify the same target lesions, measure the same lesions and calculate SLD
- Assess “non-target lesions”

<table>
<thead>
<tr>
<th>RECIST 1.1</th>
<th>Baseline Study</th>
<th>Follow Up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target lesions</td>
<td>- length diameter tumor &gt;10mm&lt;br&gt;- max 5, max 2 per organ&lt;br&gt;- short axis lymph node &gt;15mm&lt;br&gt;- Determine SLD sum of length diameters</td>
<td>Determine SLD</td>
</tr>
<tr>
<td>Non-target lesions</td>
<td>- lesions &lt;10mm&lt;br&gt;- non-measurable like pleural fluid, ascites, lymphangitis</td>
<td>Disappearance? Stable? Progression?</td>
</tr>
</tbody>
</table>
Basics of RECIST 1.1 - Follow-up

- Don’t’s
- Don’t change target or non-target lesions
- Don’t measure lesions after local therapy (RF ablation, radiotherapy etc.). Label them as non-evaluable
- Don’t classify “new” sclerotic bone lesions as progressive disease
- Check for “new” lesions

Response Categories

<table>
<thead>
<tr>
<th>Response</th>
<th>Target lesions</th>
<th>Non-target</th>
<th>New lesions</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR</td>
<td>Disappearance of all target lesions</td>
<td>Disappearance of all non-target lesions</td>
<td>No</td>
</tr>
<tr>
<td>PR</td>
<td>Lymph node axis &lt; 10 mm</td>
<td>Normalization of tumor marker levels</td>
<td>Partial Response</td>
</tr>
<tr>
<td>PD</td>
<td>30% ≥ decrease in SLD from baseline (≥ 4 weeks)</td>
<td>No progression</td>
<td>No</td>
</tr>
<tr>
<td>SD</td>
<td>≥ 20% increase in SLD from Nadir with an absolute SoD increase ≥ 5 mm</td>
<td>Unequivocally progression in lesion size</td>
<td>Yes, appearance of new unequivocally metastatic lesions</td>
</tr>
<tr>
<td></td>
<td>Neither PR nor PD with the Nadir as reference point</td>
<td>Persistence of one or more non-target lesions and/or tumor markers ≥ normal</td>
<td>No</td>
</tr>
</tbody>
</table>

*Nadir is the smallest sum of diameters (SLD) during treatment.*
Time point response

<table>
<thead>
<tr>
<th>Target lesions</th>
<th>Non-target lesions</th>
<th>New lesions</th>
<th>Overall response</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR</td>
<td>CR</td>
<td>No</td>
<td>Complete Response</td>
</tr>
<tr>
<td>CR</td>
<td>Non-CR / non-PD</td>
<td>No</td>
<td>Partial Response</td>
</tr>
<tr>
<td>CR</td>
<td>NE</td>
<td>No</td>
<td>Partial Response</td>
</tr>
<tr>
<td>PR</td>
<td>Non-PD or NE</td>
<td>No</td>
<td>Partial Response</td>
</tr>
<tr>
<td>SD</td>
<td>Non-PD or NE</td>
<td>No</td>
<td>Stable Disease</td>
</tr>
<tr>
<td>Not Evaluated</td>
<td>Non-PD</td>
<td>No</td>
<td>Un evaluable</td>
</tr>
<tr>
<td>PD</td>
<td>Any</td>
<td>Yes / no</td>
<td>Progressive Disease</td>
</tr>
<tr>
<td>Any</td>
<td>PD</td>
<td>Yes / no</td>
<td>Progressive Disease</td>
</tr>
<tr>
<td>Any</td>
<td>Any</td>
<td>Yes</td>
<td>Progressive Disease</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Non-target lesions</th>
<th>New lesions</th>
<th>Overall response</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR</td>
<td>No</td>
<td>CR</td>
</tr>
<tr>
<td>Non-CR/non-PD</td>
<td>No</td>
<td>Non-CR / Non-PD</td>
</tr>
<tr>
<td>Not all evaluated</td>
<td>No</td>
<td>Un evaluable</td>
</tr>
<tr>
<td>Unequivocal PD</td>
<td>Yes or No</td>
<td>PD</td>
</tr>
<tr>
<td>Any</td>
<td>Yes</td>
<td>PD</td>
</tr>
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</table>

Figure 2: Longitudinal response categorization. At each imaging time point, the patient will receive a single categorical response. When there is a partial treatment response (PR), the time point with the smallest tumor burden is the nadir (green arrow). Provided there are no changes in non-target lesions and no new lesions, when the smallest tumor burden increases by more than 20% from nadir (or baseline [yellow arrow], if no nadir), this is the date of disease progression (PD) (red arrow). Lines on bottom images indicate tumor diameter.

Ruchalski K. Published Online: May 14, 2021
https://doi.org/10.1148/rycan.2021210008
77 yo male. Bladder cancer, cystoprostatectomy

Target lesion #1, Left Periaortic LAP, SAD

Baseline

Follow-up

77 yo male. Bladder cancer, cystoprostatectomy

Target lesion #2, Right External Iliac LAP, SAD

Baseline

Follow-up
77 yo male. Bladder cancer, cystoprostatectomy

Target lesion #3, Left Pelvic Lesion, LAD

Baseline

Follow-up

Target Lesion  Sum of Diameters

- Sum of diameters baseline: 3.4+2.7+4.2= 10.3 cm
- Sum of diameters follow-up 1: 3.2+2.6+4.9 =10.7cm
- 3.9% increase in size = SD (stable disease)
- No new lesion
Non-Target Lesion Assessment
Notes about assessment of progression of non-target lesions

- Unequivocal Progression: Substantial worsening in non-target lesions
- Modest increases not sufficient to call progressive disease

Response Criteria

- Target lesions that become “too small to measure” while on study should have their actual measurements recorded, if visible but cannot measured a default value of 5 mm can be assigned
- Target lesions that become non-measurable, a value of 0 can be assigned
Example: 51 yo male, esthesioneuroblastoma

Baseline  Follow-up 1 (3 months)  Follow-up 2

Additional Finding

Baseline  Follow-up 1  Follow-up 2
Follow-up 2 Aspiration related pneumonia?

After aspiration prevention and treatment

Fragmentation of a lesion

<table>
<thead>
<tr>
<th>Baseline</th>
<th>Follow up</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ a ]</td>
<td>[ a + b ]</td>
</tr>
</tbody>
</table>

SLD = a + b
Radiology Workflow in NIH

• Image Processing Services section closed
• Teams assign their responsible person for tumor measurements
• Collaboration with radiology (AI in the protocol, co-authorship)

Main publications

Websites

- https://radiologyassistant.nl/more/recist-1-1/recist-1-1
- https://www.radiologytutor.com/index.php/cases/oncol/139-recist

Thank You!

- Elizabeth Jones
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