Revascularization strategy of multivessel PCI – data from a worldwide registry

David Hildick-Smith
On behalf of e-Ultimaster investigators
☑ I have the following potential conflicts of interest to report:

Advisory/Consultancy to Terumo
Patients with multivessel coronary artery disease (MVD) are at increased risk of adverse clinical outcomes following PCI.

More frequent use of PCI to treat MVD.

The value and timing of complete revascularization over incomplete revascularization is uncertain in patients with MVD.

(Current ESC guidelines do not give the highest class of recommendation regarding completeness of myocardial revascularization.)
Revascularization strategy in multivessel disease patients* treated with contemporary DES

**STUDY METHODS**

**WHAT DID WE STUDY?**

Complete revascularization at index procedure**

Incomplete revascularization at index procedure

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**Revascularization strategy**

**Clinical outcomes**

Angina status
Safety endpoints
Efficacy endpoints

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**Ultimaster DES**

<table>
<thead>
<tr>
<th>Platform</th>
<th>Strut thickness (80 µm) Co-Cr Open cell design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drug Carrier</td>
<td>PDLLA-PCL copolymer resorbed within 3-4 months</td>
</tr>
<tr>
<td>Coating</td>
<td>Abluminal bioresorbable gradient coating technology</td>
</tr>
<tr>
<td>Drug</td>
<td>Sirolimus - 3.9 µg/mm stent length</td>
</tr>
</tbody>
</table>

*Multivessel disease is defined as the presence of a >50% diameter stenosis in more than 1 coronary artery

**Also includes procedures which occurred after the initial (index) procedure within the period before discharge from hospital
e-Ultimaster registry
4 continents, 50 countries, 376 sites

Study enrolment completed, follow-up ongoing
> 37,000 patients enrolled

Interim analysis
1-year follow-up
n=25,990 patients
n=9,164 MVD patients

COMPLETE
revascularization
n=3,777 patients

INCOMPLETE
revascularization
n=5,387 patients

Clinical follow-up
0 d
3 m
1 y

An independent Clinical Event Committee reviewed and adjudicated all endpoint-related serious adverse events
Inverse probability of treatment weights (IPTW) methodology

- The Inverse Probability of Treatment Weights (IPTW) method creates balanced groups for comparison of subgroups that are not randomized and as a consequence, do not allow for direct statistical comparison due to the resulting imbalance in covariates (baseline characteristics).

- A logistic regression model, containing all covariates that require balancing as predictive factors and subgroup of interest as outcome, predicts the probability for each subject of belonging to the subgroup he is in (propensity scores'), based on the array of covariates (see graph).

- The IPTW are then the inverse of these propensity scores (1/PS), and can be used as weight to balance the subgroups, i.e. the covariates become similar between the subgroups.

- By performing weighted statistical analyses on the outcomes, using these inverse propensity weights, the results can be interpreted for the subgroup comparison, balanced for the covariates included in the initial logistic regression model that calculates the propensity scores.

- On of the advantages of this methodology is that all patients can be included in the weighted analysis (as opposed to 1 to 1 matched analyses, where only part of the population is included).

- Covariates to calculate the propensity score include

- The y-axis gives the covariates included in the propensity score; the x-axis gives the standardized difference between complete and incomplete revascularization group before and after weighted analyses
### BASELINE PATIENT CHARACTERISTICS

Unadjusted data; values are mean±SD or percentages.

<table>
<thead>
<tr>
<th></th>
<th>Complete revascularization n=3,777</th>
<th>Incomplete revascularization n=5,387</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>64.8±11.2</td>
<td>65.9±11.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Gender, male</td>
<td>78.0</td>
<td>77.5</td>
<td>0.56</td>
</tr>
<tr>
<td>Current smoking</td>
<td>23.8</td>
<td>21.3</td>
<td>0.006</td>
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<tr>
<td>Diabetes</td>
<td>30.9</td>
<td>32.8</td>
<td>0.07</td>
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<tr>
<td>Hypertension</td>
<td>65.5</td>
<td>71.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>59.0</td>
<td>59.1</td>
<td>0.97</td>
</tr>
<tr>
<td>Renal disease</td>
<td>7.4</td>
<td>10.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Haemodialysis</td>
<td>1.2</td>
<td>1.1</td>
<td>0.76</td>
</tr>
<tr>
<td>Previous MI</td>
<td>21.8</td>
<td>29.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Previous PCI</td>
<td>25.6</td>
<td>29.0</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
## BASELINE LESION/PROCEDURE CHARACTERISTICS

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</thead>
<tbody>
<tr>
<td>Bifurcation per patient</td>
<td>18.4</td>
<td>13.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Left main per patient</td>
<td>6.5</td>
<td>4.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>N of lesions treated per patient, n</td>
<td>2.4±0.7</td>
<td>1.4±0.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>N of stents implanted per patient, n</td>
<td>2.7±1.1</td>
<td>1.7±0.9</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total stent length per patient, mm</td>
<td>45.8±27</td>
<td>32.5±20.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Type C lesions (AHA/ACC) per lesion</td>
<td>25.1</td>
<td>28.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Moderate/severe calcification per lesion</td>
<td>18.0</td>
<td>21.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Direct stenting per lesion</td>
<td>39.5</td>
<td>32.1</td>
<td>&lt;0.001</td>
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<tr>
<td>Post-dilatation per lesion</td>
<td>39.0</td>
<td>43.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Imaging per patient</td>
<td>5.1</td>
<td>3.4</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Unadjusted data; values are mean±SD or percentages
BASELINE CLINICAL PRESENTATION

Complete revascularization

STEMI 15%
NSTEMI 26%
Stable angina 37%
Silent ischemia 11%
Unstable angina 11%

Incomplete revascularization

STEMI 23%
NSTEMI 28%
Stable angina 28%
Silent ischemia 8%
Unstable angina 13%

(N)STEMI: (non) ST-elevated myocardial infarction
Results based on propensity weighted analysis
Results based on propensity weighted analysis

* Bleeding was defined according to Bleeding Academic Research Consortium (BARC):
  - minor bleeding BARC type 1-2
  - major bleeding BARC type 3-5
SAFETY ENDPOINTS AT 1 YEAR

- **Complete revascularization**
- **Incomplete revascularization**

### Event Rate, %

<table>
<thead>
<tr>
<th>Event Type</th>
<th>Complete Revascularization</th>
<th>Incomplete Revascularization</th>
<th>p-Value</th>
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</thead>
<tbody>
<tr>
<td>All-cause mortality</td>
<td>1.9</td>
<td>3.3</td>
<td>&lt;0.001</td>
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<tr>
<td>Cardiac mortality</td>
<td>1.3</td>
<td>2.1</td>
<td>0.003</td>
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<tr>
<td>Any MI</td>
<td>1.1</td>
<td>1.3</td>
<td>0.46</td>
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<tr>
<td>Target vessel MI</td>
<td>0.9</td>
<td>1.0</td>
<td>0.48</td>
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<tr>
<td>Stent thrombosis</td>
<td>0.5</td>
<td>0.8</td>
<td>0.09</td>
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**Results based on propensity weighted analysis**

*MI: myocardial infarction; Stent thrombosis: Definite + probable stent thrombosis*
RESULTS BASED ON PROPENSITY WEIGHTED ANALYSIS

**POCE**: patient-oriented composite endpoint (all-cause mortality, any MI, any revascularization); **TLF**: target lesion failure (cardiac death, TV-MI and clinically driven target lesion revascularization); **TVF**: target vessel failure (cardiac death, TV-MI, clinically driven target vessel revascularization; **TLR**: target lesion revascularization; **TVR**: target vessel revascularization
Data reported from a subgroup of a large, prospective, world-wide registry on PCI treatment of multivessel CAD with a contemporary DES

- Less angina at 1 year with complete revascularisation
- Lower mortality at 1 year with complete revascularisation
- Physician-directed selective use of complete revascularization results in good clinical outcomes
### Acknowledgments

On behalf of all e-Ultimaster investigators and participating sites

**e-Ultimaster top-enrollers**

<table>
<thead>
<tr>
<th>Investigator Name</th>
<th>Country</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Albert Schweitzer Ziekenhuis</td>
<td>Netherlands</td>
<td>CHR Orleans Cardiologie</td>
<td>France</td>
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<tr>
<td>The Almaty City Heart Center</td>
<td>Kazakhstan</td>
<td>Hospital General Castellón</td>
<td>Spain</td>
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<tr>
<td>Amphia Ziekenhuis</td>
<td>Netherlands</td>
<td>Catharina Ziekenhuis</td>
<td>Netherlands</td>
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<tr>
<td>Jeroen Bosch Ziekenhuis</td>
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<td>Hôpitaux Universitaires de Genève</td>
<td>Switzerland</td>
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<tr>
<td>Royal Stoke University Hospital</td>
<td>United Kingdom</td>
<td>Pavlodar Regional Cardiologic Center</td>
<td>Kazakhstan</td>
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<tr>
<td>North-Estonia Medical Center</td>
<td>Estonia</td>
<td>Hospital Universitario de Guadalajara</td>
<td>Spain</td>
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<tr>
<td>Hospital San Juan De Dios</td>
<td>Chile</td>
<td>Meander MC</td>
<td>Netherlands</td>
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<tr>
<td>Groupement mutualiste de Grenoble</td>
<td>France</td>
<td>Hospital Meixoeiro-Medtec</td>
<td>Spain</td>
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<td>MBAL Sveta Karidad, Plovdiv</td>
<td>Bulgaria</td>
<td>Hopital Privé Jacques Cartier Massy</td>
<td>France</td>
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<tr>
<td>New Cross Hospital</td>
<td>United Kingdom</td>
<td>Hospital Grant Benavente</td>
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<tr>
<td>Worcestershire Acute Hospitals NHS Trust</td>
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<td>Clinique Internationale de Marrakech</td>
<td>Morocco</td>
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<td>University Hospital Galway</td>
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<td>Royal Sussex Hospital, Brighton</td>
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<td>GKNM Hospital</td>
<td>India</td>
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<tr>
<td>National Heart Foundation Hospital and</td>
<td>Bangladesh</td>
<td>Universitets Sjukhuset I Örebro</td>
<td>Sweden</td>
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<td>Research Institute</td>
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<td>Medisch Spectrum Twente</td>
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<tr>
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Dr H. Routledge                          |                  |                                        |                  |
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