Background: Most precision cancer medicine efforts are based on the identification of oncogenic driver mutations by genome sequencing. We believe and have emerging evidence that this will miss therapeutic opportunities and additional technologies, such as cell-based functional testing should be included. Pioneering studies in leukemia indicate the value of in-vivo drug testing to identify novel, clinically actionable therapeutic opportunities1,2.

Methods: Using conditional re-programming technology, we established patient-derived cells (PDCs) from castration-resistant prostate cancer (CRPC)3 and renal cell cancer (RCC) in order to pilot precision systems medicine in solid tumours. The PDCs were compared with primary tumour tissue by genomic profiling and then subjected to drug sensitivity profiling with >306 approved and investigational oncology drugs.

Results: Here, we generated both benign and malignant PDCs from prostate tissue, including six benign PDCs that were androgen receptor (AR)-negative, basal/transit-amplifying phenotype, but could re-express AR in 3D culture. The PDCs from a CRPC patient displayed multiple CNAs, some of which were shared with the parental tumor4. The cancer-selective drug profile for these PDCs showed sensitivity to taxanes, navitoclax, bexarotene, tretinoin, oxaliplatin and mepacrine3.

RCC displays extensive intra-tumour heterogeneity and clonal evolution. There is, however, very little information on how much this impacts drug sensitivities. Therefore, we generated several PDCs from each RCC patient across multiple tumour regions. We verified their clonal relationship with the uncultured tumour tissue by NGS and performed drug sensitivity profiling. The PDCs retained CNAs and driver mutations in e.g. VHL, PBRM1, PIK3C2A, KDM5C, TSC2 genes present in the original tumour tissue. Drug testing with 461 oncology drugs identified shared vulnerability among the multiple PDCs to pazopanib and temsirolimus that inhibit well-established renal cancer pathways VEGFR/POGFR/FGFR and mTOR. Importantly, however, the individual PDC from different regions in one patient also showed distinct drug response profiles, confirming that genomic heterogeneity leads to variability in drug responses5.

Conclusions: Our aim is to generate molecular profiles and drug testing data using representative PDCs from each patient to help clinicians in treatment decision and to facilitate the early selection of the best drug candidates for clinical development. We believe this approach will help to personalize treatment, prioritize drugs for clinical testing, provide for intelligent selection of drug combinations and improve treatment outcomes.

Legal entity responsible for the study: University of Helsinki

Funding: EU-FP7-Systems Microscopy Network of Excellence, Sigrid Juselius Foundation, Cancer Society of Finland, Academy of Finland, the Magnus Ehrnrooth Foundation, TEKES FiDiPro Fellow Grant and Knut and Alice Wallenberg Foundation.

Disclosure: T. M. af Hållström is an employee of Orion Pharmaceuticals, O. Kallioniemi is a co-founder and board member of Medisapiens bioinformatics company and has been supported by research grants from Roche, Bayer and Pfizer.