

## MEETING ABSTRACT

## Open Access

# Construction of novel cGMP FRET-sensors based on PKG from *Plasmodium falciparum*

Gaia Calamera<sup>1,2</sup>, Andrea Hembre Ulsund<sup>1,2</sup>, Ornella Manfra<sup>1,2</sup>, Jeong Joo Kim<sup>3</sup>, Choel Kim<sup>3</sup>, Finn Olav Levy<sup>1,2</sup>, Kjetil Wessel Andressen<sup>1,2\*</sup>*From* 7th International Conference on cGMP Generators, Effectors and Therapeutic Implications Trier, Germany. 19-21 June 2015

## Background

Several sensors for cyclic nucleotides have been developed the past decade. However, there are few sensors for cGMP available and even fewer that detect low concentrations of cGMP. Currently, only the CFP/YFP sensors Cygnet 2.1, cGES-DE5 and cGi-500 (EC<sub>50</sub> ~1.7 μM, 1.5 μM and 500 nM, respectively) and the T-sapphire/Dimer2 sensor Red cGES-DE5 (EC<sub>50</sub> ~40 nM) are available [1-3]. We aim to measure localized pools of cGMP in single adult cardiac myocytes, and have previously found that such sensors should have an EC<sub>50</sub> less than 50 nM, thus excluding the CFP/YFP sensors above. The Red cGES-DE5 has an acceptable EC<sub>50</sub>, but tagging this sensor to locate in distinct compartments within cardiac myocytes yielded sensors with a smaller dynamic range. We therefore decided to construct new FRET-based cGMP-sensors with high affinity for cGMP that could be better candidates for subcellular localization.

## Methods

Based on the recent crystallization of *Plasmodium falciparum* cGMP-dependent Protein Kinase [4], sensors for cGMP were constructed using the cyclic nucleotide-binding domain D flanked with different FRET-pairs (either CFP/Citrine or T-sapphire/Dimer2) in its N- and C-terminal to generate two different sensors for cGMP, excitable at various wavelengths. Sensors were then expressed in HEK293 cells and their activity tested *in vitro* by measuring FRET upon addition of cGMP.

## Results

Sensors with high affinity for cGMP (EC<sub>50</sub> of 26 ± 14 nM) were constructed. We also determined that the affinity for cAMP was almost 50 fold lower (1 ± 0.5 μM).

## Conclusion

We have constructed FRET-based cGMP sensors with high affinity for cGMP that can be utilized in single cells when concentrations of cAMP are less than 0.1 μM.

## Authors' details

<sup>1</sup>Department of Pharmacology, University of Oslo and Oslo University Hospital, Oslo, Norway. <sup>2</sup>K.G. Jebsen Cardiac Research Centre and Center for Heart Failure Research, University of Oslo, Oslo, Norway. <sup>3</sup>Department of Pharmacology, Baylor College of Medicine, Houston, TX, USA.

Published: 2 September 2015

## References

1. Nikolaev VO, Gambaryan S, Lohse MJ: **Fluorescent sensors for rapid monitoring of intracellular cGMP.** *Nat Methods* 2006, **3**(1):23-25.
2. Russwurm M, Mullershausen F, Friebe A, Jäger R, Russwurm C, Koesling D: **Design of fluorescence resonance energy transfer (FRET)-based cGMP indicators: a systematic approach.** *Biochem J* 2007, **407**(1):69-77.
3. Niino Y, Hotta K, Oka K: **Simultaneous Live Cell Imaging Using Dual FRET Sensors with a Single Excitation Light.** *PLoS One* 2009, **4**(6):e6036.
4. Kim JJ, Flueck C, Franz E, Sanabria-Figueroa E, Thompson E, Lorenz R, et al: **Crystal Structures of the Carboxyl cGMP Binding Domain of the *Plasmodium falciparum* cGMP-dependent Protein Kinase Reveal a Novel Capping Triad Crucial for Merozoite Egress.** *PLoS Pathog* 2015, **11**(2): e1004639.

doi:10.1186/2050-6511-16-S1-A34

**Cite this article as:** Calamera et al.: Construction of novel cGMP FRET-sensors based on PKG from *Plasmodium falciparum*. *BMC Pharmacology and Toxicology* 2015 **16**(Suppl 1):A34.

\* Correspondence: [k.w.andressen@medisin.uio.no](mailto:k.w.andressen@medisin.uio.no)<sup>1</sup>Department of Pharmacology, University of Oslo and Oslo University Hospital, Oslo, Norway

Full list of author information is available at the end of the article