Research Projects for Molecular Imaging Inflammation in Cancer (PAR)

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Molecular Imaging Techniques to Characterize Cancer Inflammation

- Inflammation plays a role in cancer behavior and treatment outcomes

- The cellular physiology of cancer inflammation is not well understood;

- Cancer inflammation is dynamic and heterogeneous;

- *In vivo* imaging can quantitate cancer inflammation dynamics and heterogeneity non-invasively

Chronic Inflammation WG
Established in Sept 2016, ICs: NCI, NIA, NIDCR, NIAID, NINR, NEI, NHLBI, NIDDK, ODS
NCI Divisions: DCTD (CIP, CTEP), DCCPS, DCP, DCB

Trans-NIH Workshops on Chronic Inflammation

Workshop on Chronic Inflammation Biomarkers in Disease Development and Prevention
May 31-June 1, 2017
Rockville, Maryland
Mechanisms, biomarker discovery, imaging and sensing, big data analysis, clinical implications

Workshop on Imaging Inflammation and its Resolution in Health and Disease
June 10-11, 2019
Rockville, Maryland
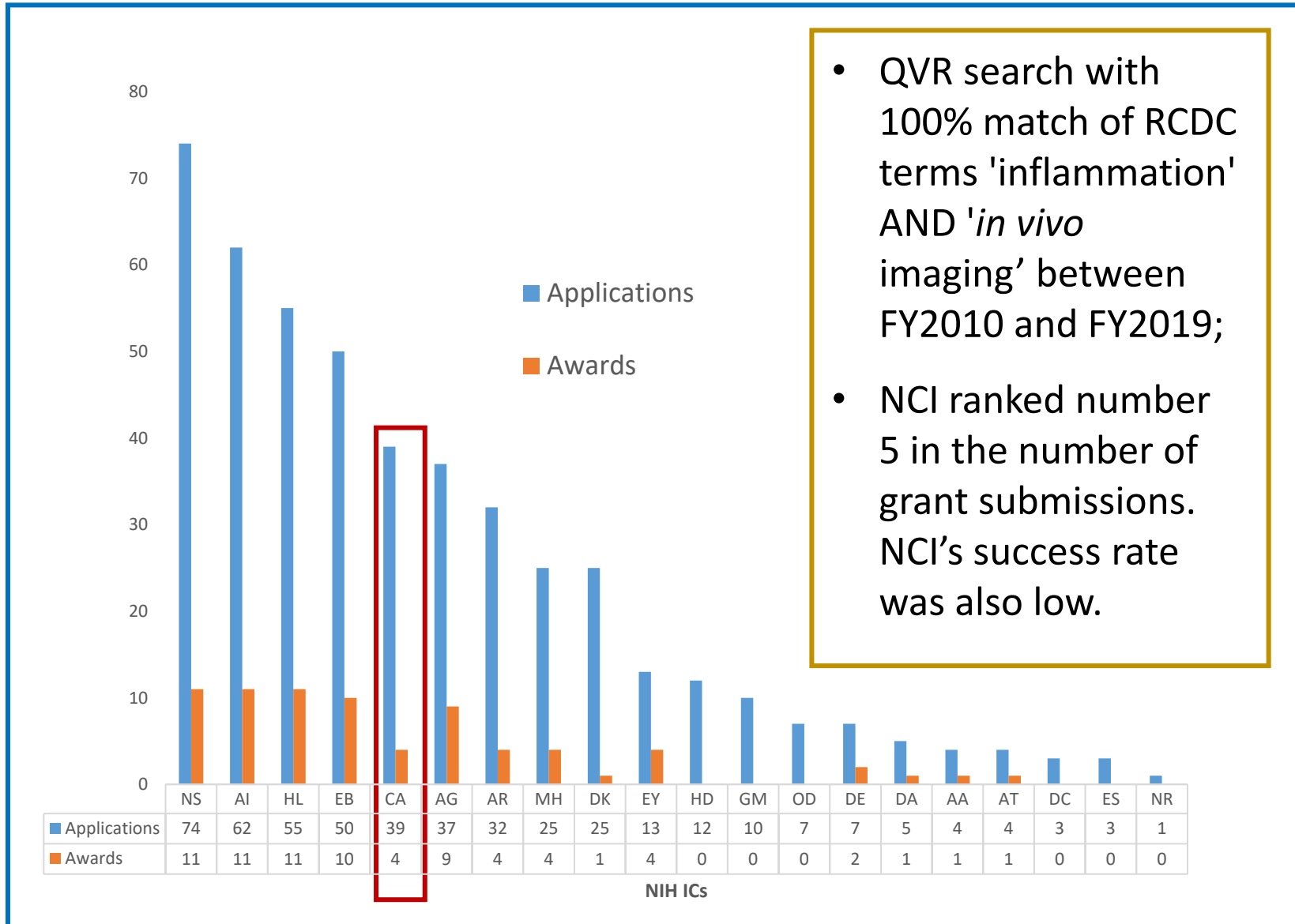*Aligning Imaging Capabilities to Address Challenges in Clinical Decisions and Patient Care*

To date:
- A large amount of epidemiological data;
- Emerging *in vivo* imaging techniques, mostly for studies of inflammation in other diseases.

Needed:
- Longitudinal data;
- Multiple markers;
- Fast imaging tools;
- Imaging approaches for clinical decisions concerning cancer inflammation.

Research Grants and Awards on *in vivo* Imaging Inflammation Across NIH

- QVR search with 100% match of RCDC terms 'inflammation' AND '*in vivo* imaging' between FY2010 and FY2019;

- NCI ranked number 5 in the number of grant submissions. NCI's success rate was also low.

	NS	AI	HL	EB	CA	AG	AR	MH	DK	EY	HD	GM	OD	DE	DA	AA	AT	DC	ES	NR
Applications	74	62	55	50	39	37	32	25	25	13	12	10	7	7	5	4	4	3	3	1
Awards	11	11	11	10	4	9	4	4	1	4	0	0	0	2	1	1	1	0	0	0

NIH ICs

Bring inflammation molecular imaging to Cancer applications

Research Examples - *In vivo* Molecular Imaging Inflammation

Techniques to **characterize immunometabolism**	Techniques to **follow inflammation-related molecules and molecular events over time**

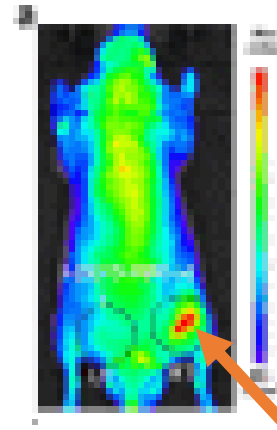| MRI of cellular oxygenation & metabolites	NIR of apoptotic tumor areas	SPECT/CT: cytokine activity
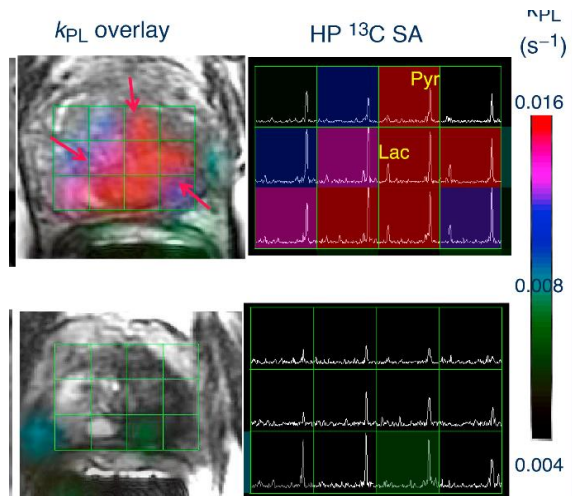
Hyperpolarized 1-[13C]-Pyruvate Magnetic Resonance Imaging Detects an Early Metabolic Response to Androgen Ablation Therapy in Prostate Cancer. *Aggarwal et al., Eur Urol. 2017 Dec;72(6):1028-1029*
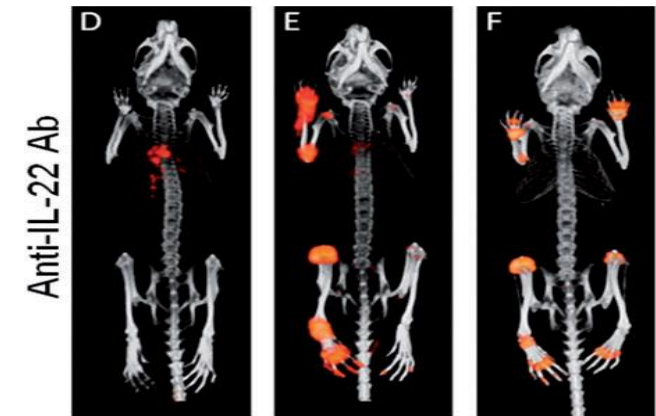
Apo-S-Ac$_3$ManNAz- and TRAIL-treated tumor tissues in PC-3 tumor-bearing mice model. Shim, *et al*, Sci Rep. 2017; 7: 16635. online 2017 Nov 30.

SPECT/CT of fibroblast activator protein (FAP) tracer. 111In-28H1 can serve as a surrogate biomarker for reduced IL-22 levels. Van der Geest *et al., Rheumatology Jan 18, 2018.*

Many promising molecular imaging probes have been developed for pre-clinical *in vivo* imaging studies in non-cancer applications (concept Appendix).

Research Projects for Molecular Imaging Inflammation in Cancer (MIIC)
Topics and Scope

Molecular imaging capabilities: Non-invasive, repeatable, fast, quantitative, specific, sensitive, high spatial resolution, robust image/data analysis

Dynamic measurements: inflammatory cellular physiology signatures, interactions and spatial information (examples below); studies of inflammatory pathways (i.e., NF-kB, STAT3, HIF)

Molecular (M)	Cellular (C)	Functional (F)	Structural (S)
CRP, IL-6, IL-10, MMP9, TLR9, IL-8, VCAM-1, ICAM-1, TLR4, IFN-g, fatty acids and receptors, oncogenes, DNA mutations	Immune cells Macrophages Stem cells Microbiota	Tissue oxygenation Fat flux Metabolites	Lesion Tissue integrity Tissue stiffness

Bring inflammation molecular imaging to Cancer applications
Cancer types focus: Cancers with known inflammatory association (non-viral origin): pancreatic, prostate, colon, urinary bladder, breast

Research Projects on Molecular Imaging Inflammation in Cancer (MIIC)

Funding mechanism, receipt dates, and reviews

- R01 PAR: five-year R01s

- Two receipt dates per year coinciding with the standard receipt dates (Feb 5 & Oct 5) to ensure sufficient submissions for each receipt date;

- Reviewed by appropriate CSR standing study sections (i.e., CTIS, ITD, EITA, RTB, IPCA, IGIS);

- Including special review criteria.