

Experiences with Immunotherapy from Denmark

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Århus Workshop in Breast Surgery
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National Center for Cancer Immune Therapy (CCIT-DK)

- Established in October 2006. Led by Prof. Inge Marie Svane and Prof. Mads Hald Andersen
- ~ 100 employees including scientific and technical staff
- Appointed the national research and competence center for immunotherapy in 2017
- CCIT-DK has carried out numerous clinical trials and facilitates quick clinical implementation of new immunotherapies



Inge Marie Svane, Director



Mads Hald Andersen, Director



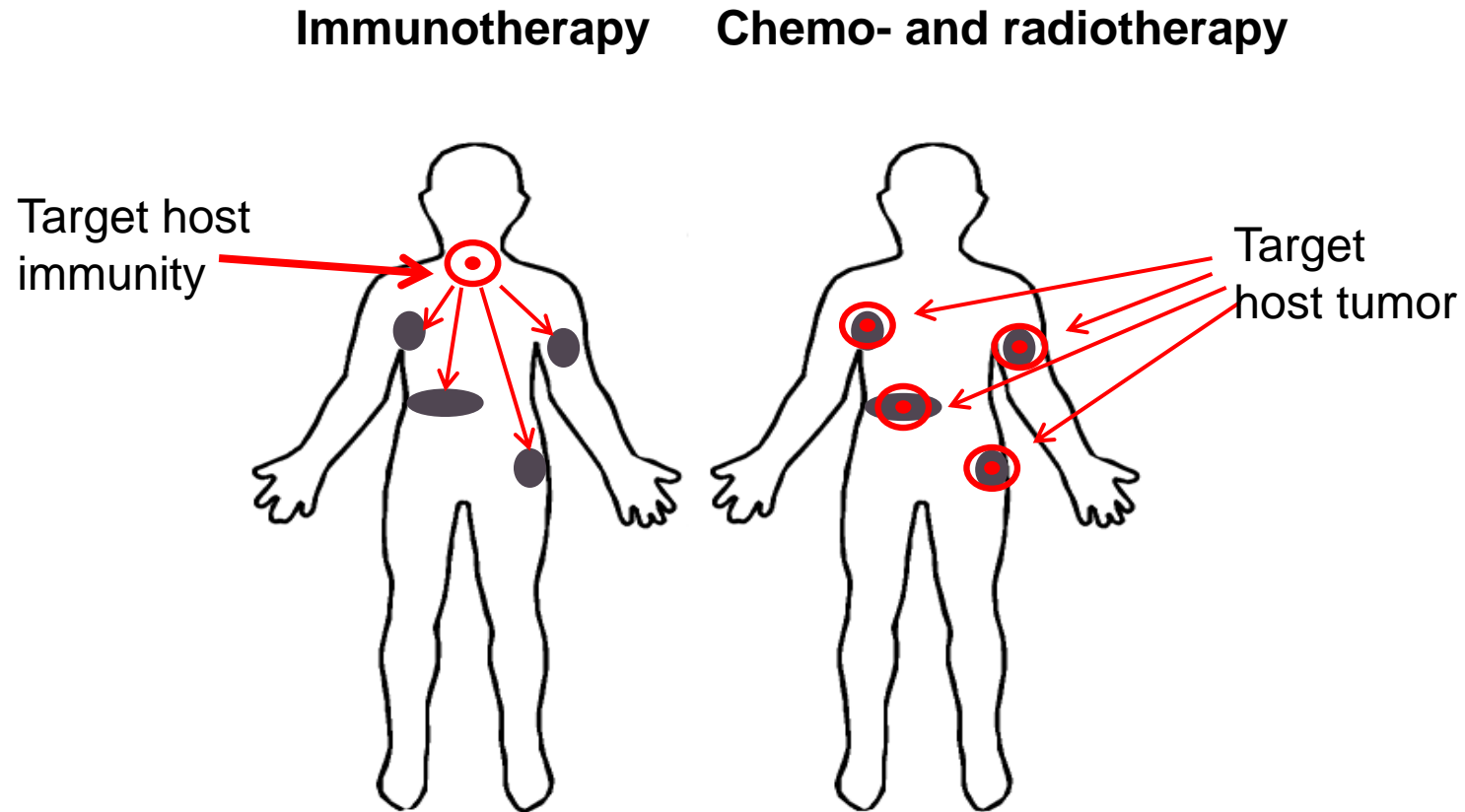
Experiences with Immunotherapy - Outline

- Introduction: Cancer Immunotherapy
 - Rationale and historical development
 - Types of immunotherapy
 - Immune Checkpoint Inhibitors (ICI)
- Efficacy (in melanoma) and challenges in response evaluation
- Which patients benefit from treatment with immunotherapy?
- Immune related toxicity: why, which, when and who?
- Neoadjuvant immunotherapy – rationale and challenges
- Perspectives

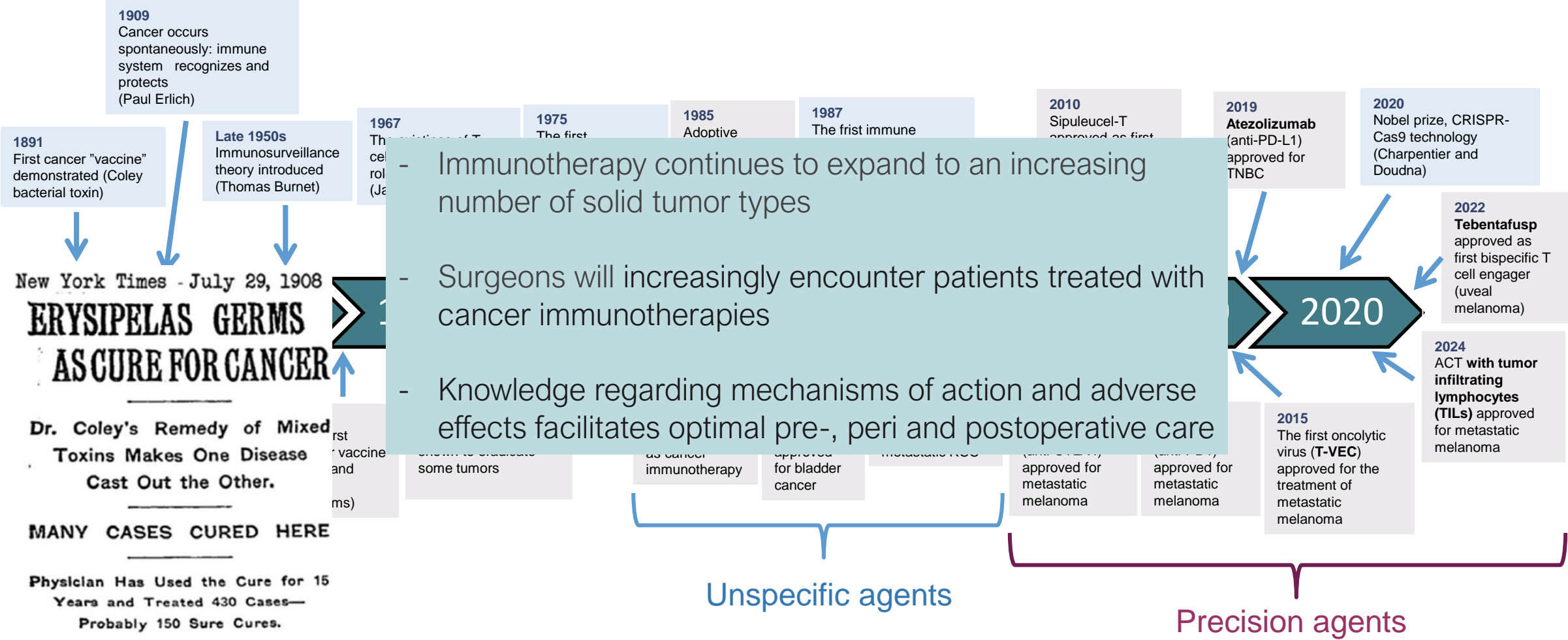
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Cancer Immunotherapy – A conceptual change in how to target cancer

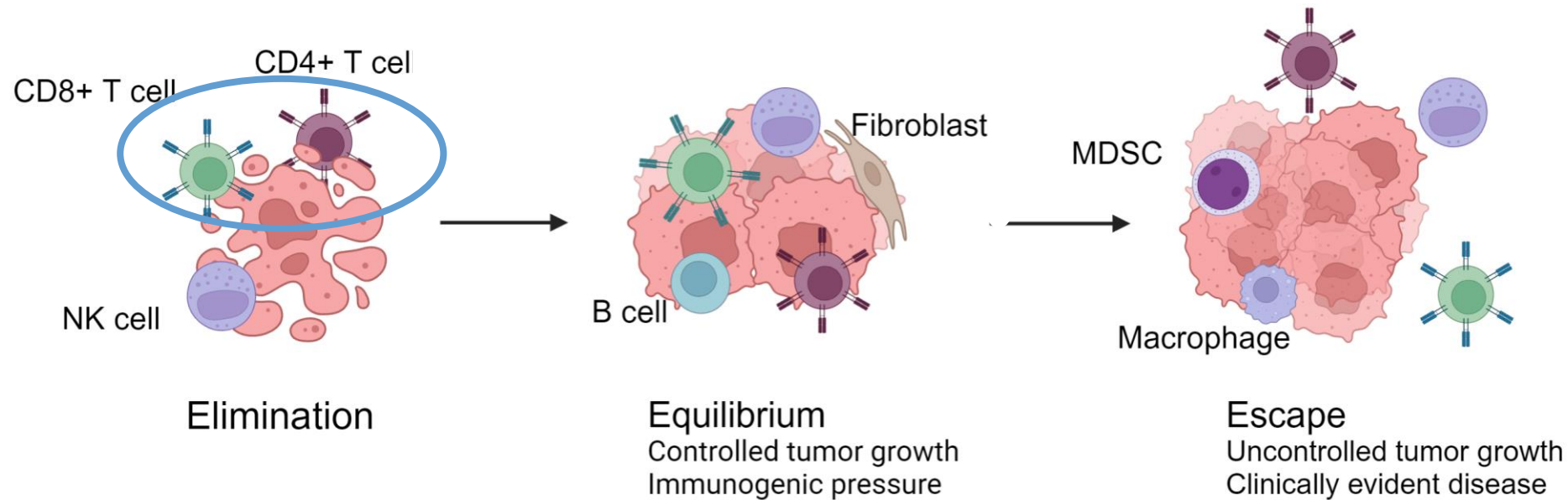


Historical points of impact in the development of Immunotherapy



Oiseth, 2017

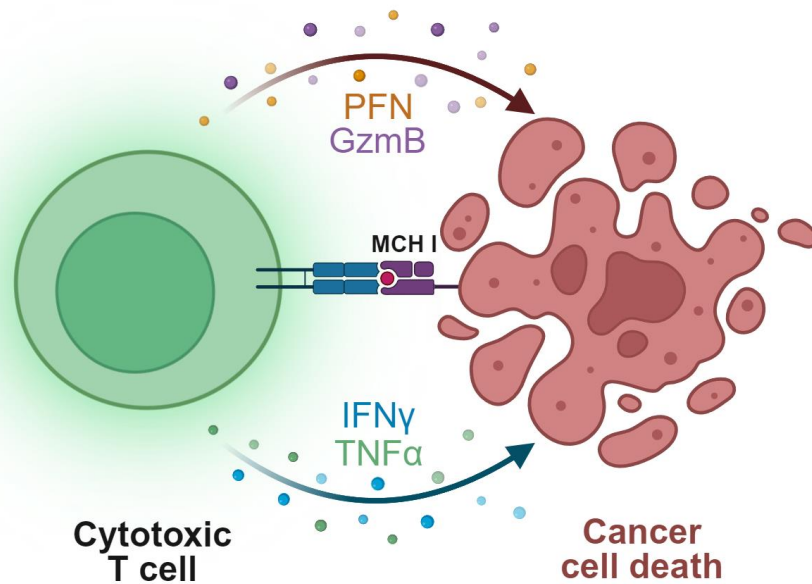
Cancer: A result of failed immunity?



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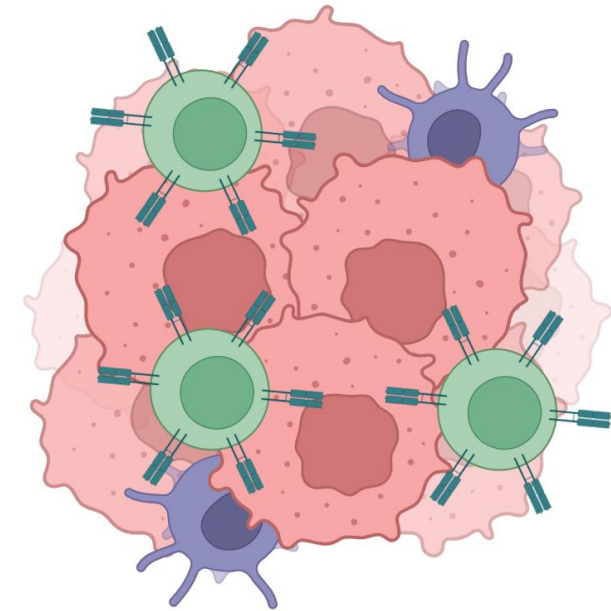
T cells are crucial players in cancer elimination

T cells can kill tumor cells in an antigen-dependent manner



Created with Biorender

Most solid tumors are infiltrated by T cells

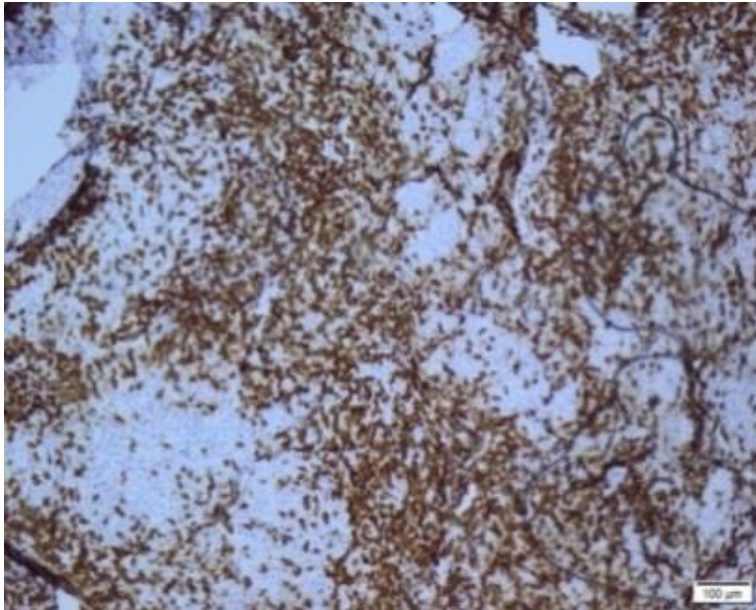


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T cell infiltration – a good prognostic marker

Most tumors are infiltrated by T-cells

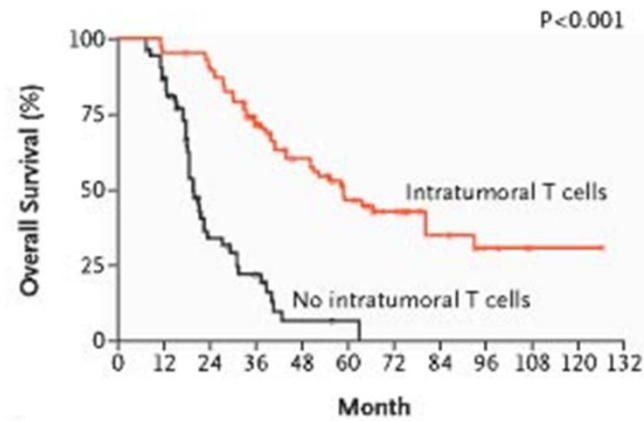
Stained for CD8⁺ T-cells



Andersen, Borch and Donia, Ann Oncol 2018

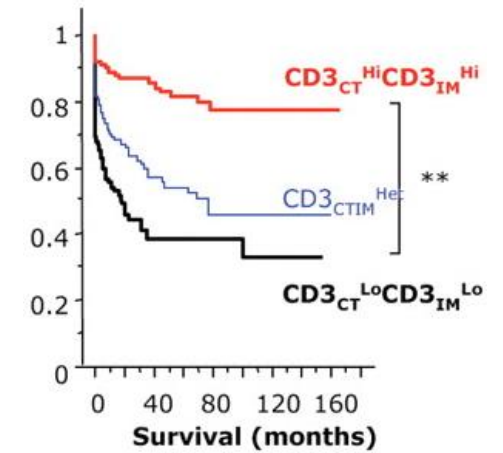
- T cell infiltration is a good prognostic marker across different cancer types

...in Ovarian Cancer



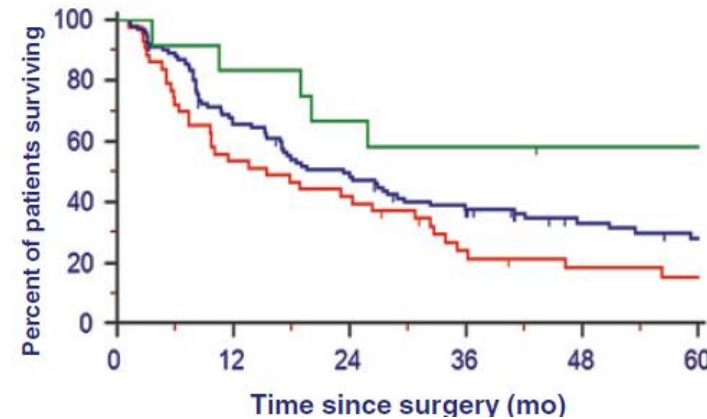
N Engl J Med 2003;348:203-13

...in Gastrointestinal Cancer



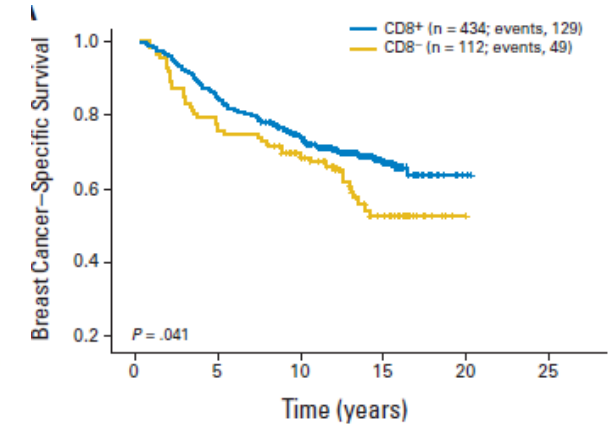
Galon J et al., Science 2006

...in Melanoma



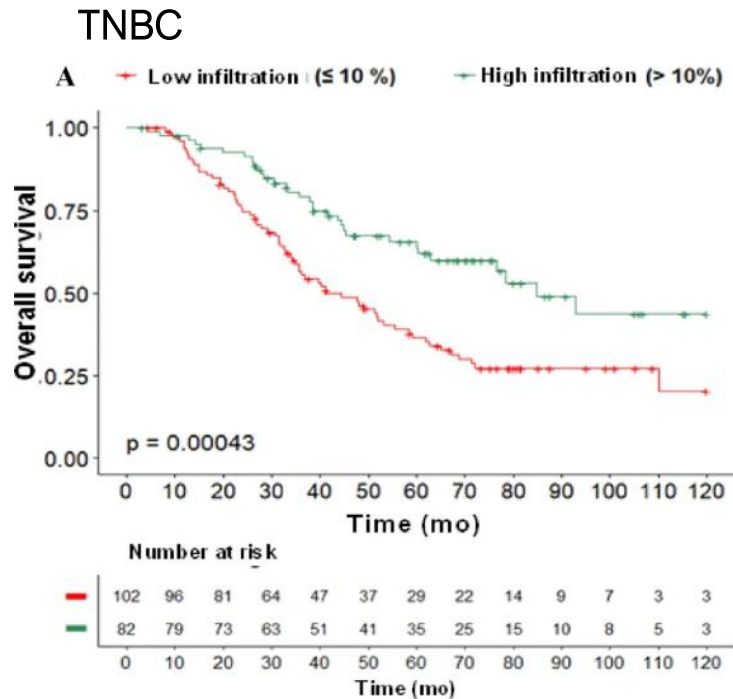
Erdag G et al., Cancer Res 2012

...in Breast Cancer



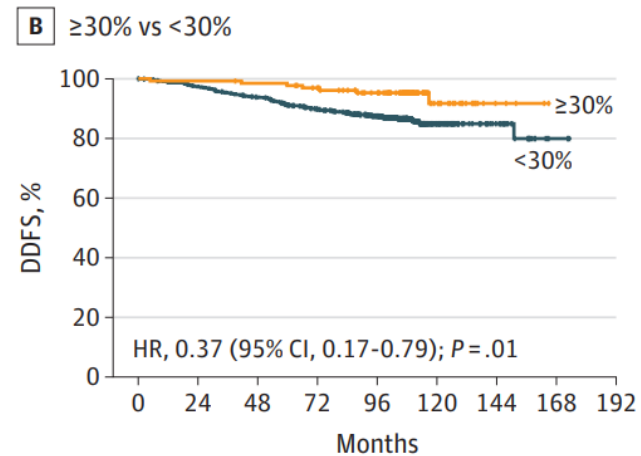
Mahmoud SM et al., JCO 2011

TILs are associated with improved survival in breast cancer subtypes



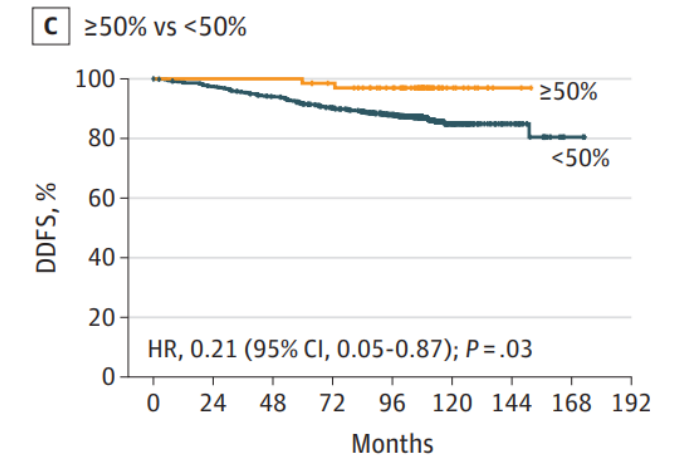
Huertas-Caro et al., 2023

HER2 positive BC



No. at risk									
$\geq 30\%$	131	130	128	121	107	23	4	0	
$< 30\%$	735	712	682	631	549	84	29	3	

Dieci et al., JAMA Oncology, 2025



No. at risk									
$\geq 50\%$	67	67	67	63	54	11	2	0	
$< 50\%$	799	775	743	689	602	96	31	3	

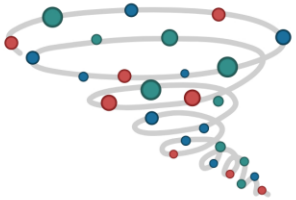
HR+/HER2- breast cancer: No prognostic value of TILs has been found. HR+/HER2- breast cancer is characterized by a low mean TIL count and a low tumor mutational burden.

Cancer Immunotherapy

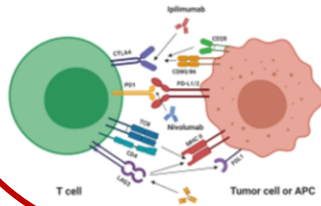
Conventional therapy



Cytokine therapy

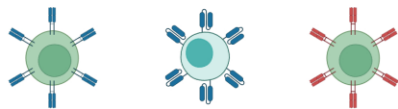


Monoclonal antibodies



Cancer immunotherapy

Adoptive Cell Therapy (ACT)



TILs

CARs

TCR



Vaccines



Oncolytic virus therapy

FDA-approved immunotherapeutic drugs for solid tumors

Non-cellular therapies

- Immune checkpoint inhibitors (PD-1/PD-L1, CTLA-4, LAG-3)
- Therapeutic cancer vaccines (for prostate cancer)
- Cytokines (IL-2, interferon-alpha)
- Oncolytic viruses (T-VEC)

Cellular therapies

- CAR-T therapy (B cell lymphoma/Myeloma)
- Tumor-infiltrating lymphocytes (TILs) (melanoma)
- TCR cell therapy (Sarcoma)

Immune Escape

Strategies to avoid immune detection

Infiltrating T cells are suppressed by the tumor microenvironment. Suppressive mechanisms are numerous.

Immune checkpoints

Molecules on the surface of the T cell.

When activated, they inhibit the function of the T cell

- CTLA-4
- PD1
- LAG3

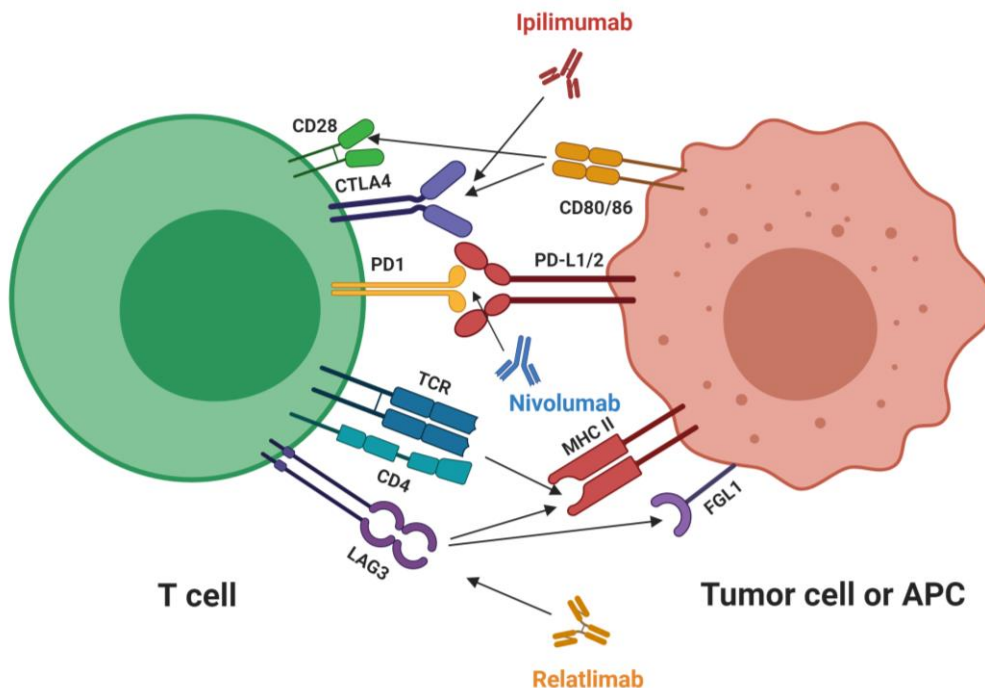


Carfromjapan.com

Immune checkpoint inhibitors (ICI)

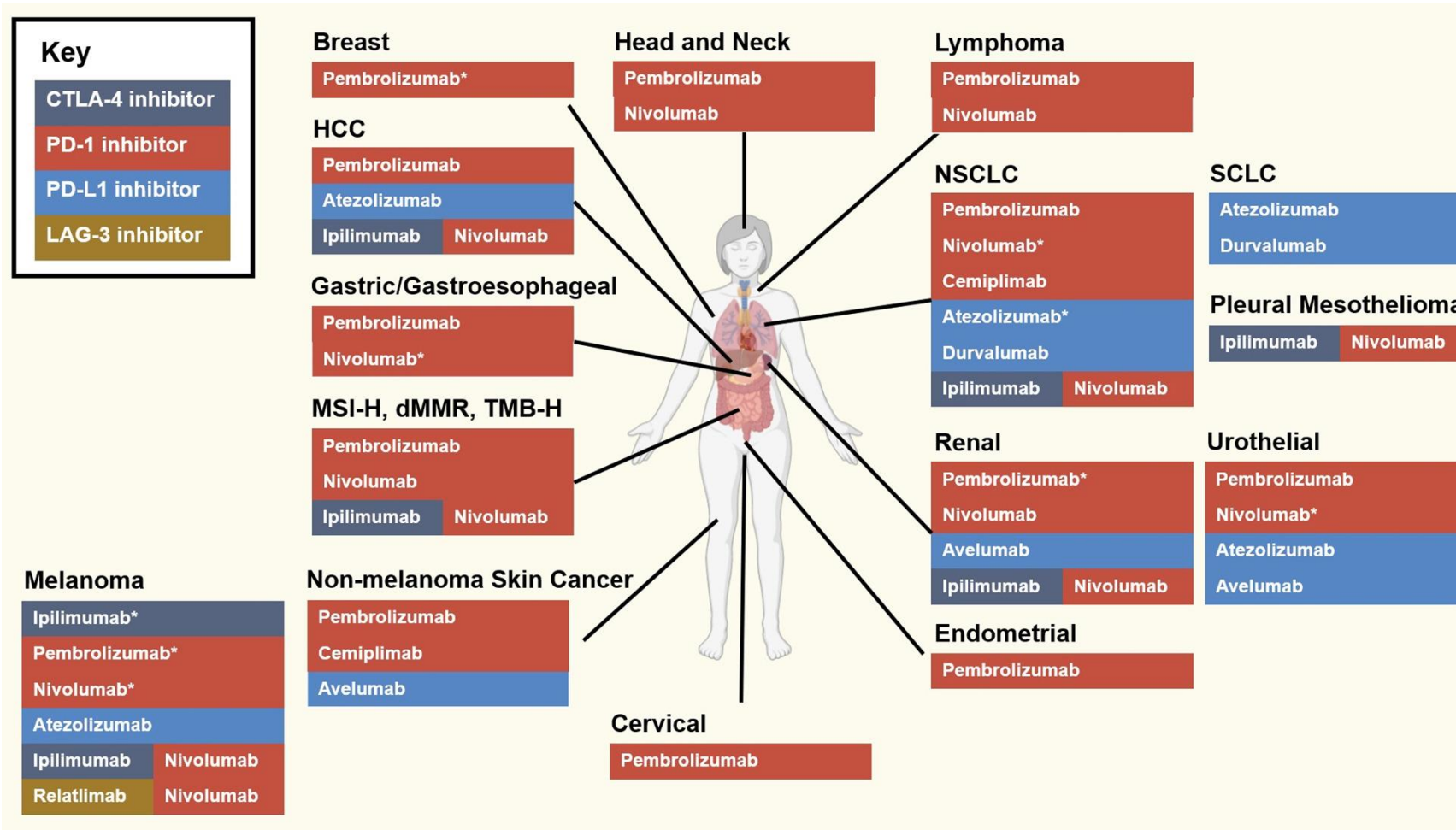
Drugs that block the inhibitory signal = **activation**

- Ipilimumab (CTLA4)
- Nivolumab/pembrolizumab ect. (PD1)
- Atezolizumab (PD-L1)
- Relatlimab (LAG3)



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Approved uses of Immune Checkpoint Inhibitors



FDA approvals (2024)

- 11 drugs targeting 4 immune checkpoints
- More than 42 indications
- Many of these are also approved in Denmark

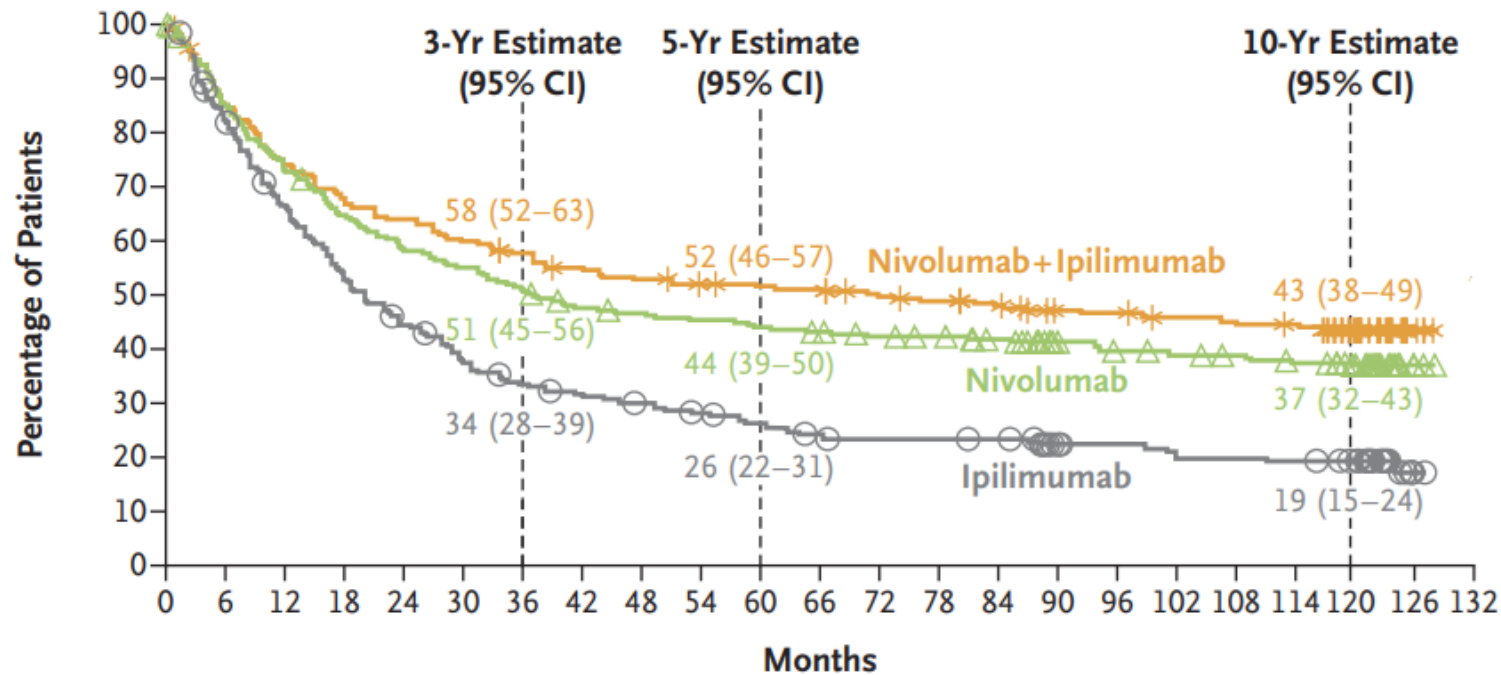
* Also approved for adjuvant or neoadjuvant setting

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Immune Checkpoint Inhibitors – A revolution in the treatment of metastatic melanoma

Overall Survival



No. at Risk

Nivo+ipi	314	265	227	210	199	187	179	169	163	158	156	153	147	144	139	126	124	120	117	115	92	10	0
Nivolumab	316	265	231	201	181	171	158	145	141	137	134	130	126	123	118	107	102	98	96	92	77	4	0
Ipilimumab	315	253	203	163	135	113	100	94	87	81	75	68	64	64	63	50	49	44	43	42	35	3	0

Median overall survival in the 70ties: < 1 years

Median overall survival today: ~ 6 years

Wolchok et al., new England journal of med., 2024

Clinical response rate to ICI therapy

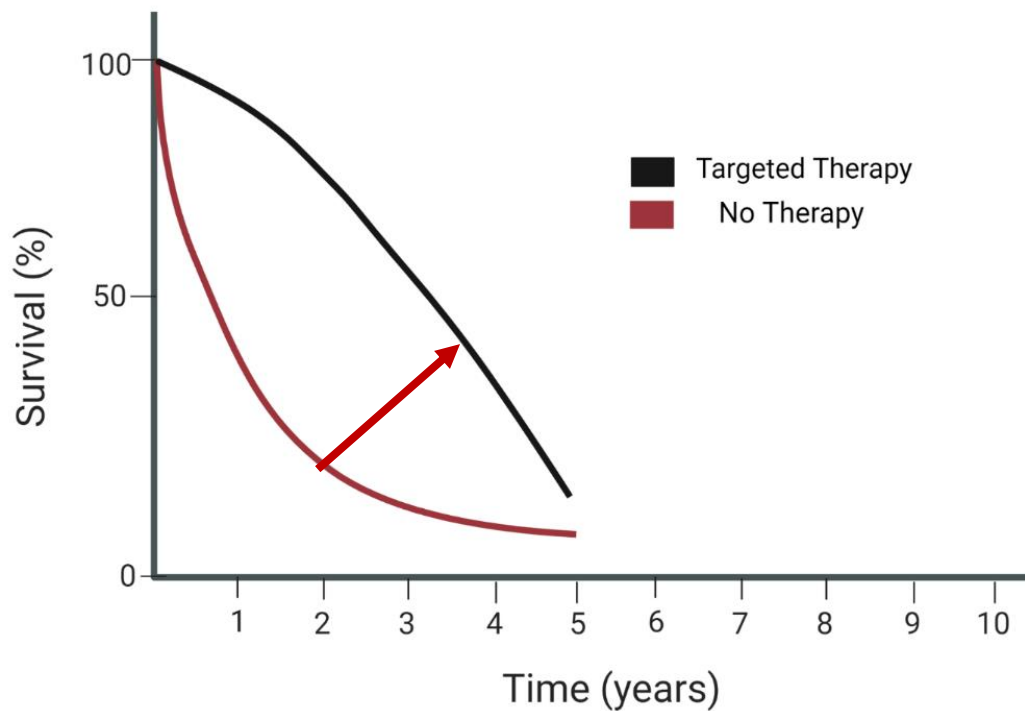
Single agent:

■ Melanoma	~35%
■ Lung cancer	~30%
■ Renal cancer	~25%
■ Gastric cancer	~15%
■ Bladder cancer	~20%
■ Head and Neck cancer	~20%
■ Colorectal cancer	<10%
■ Prostate cancer	<10%

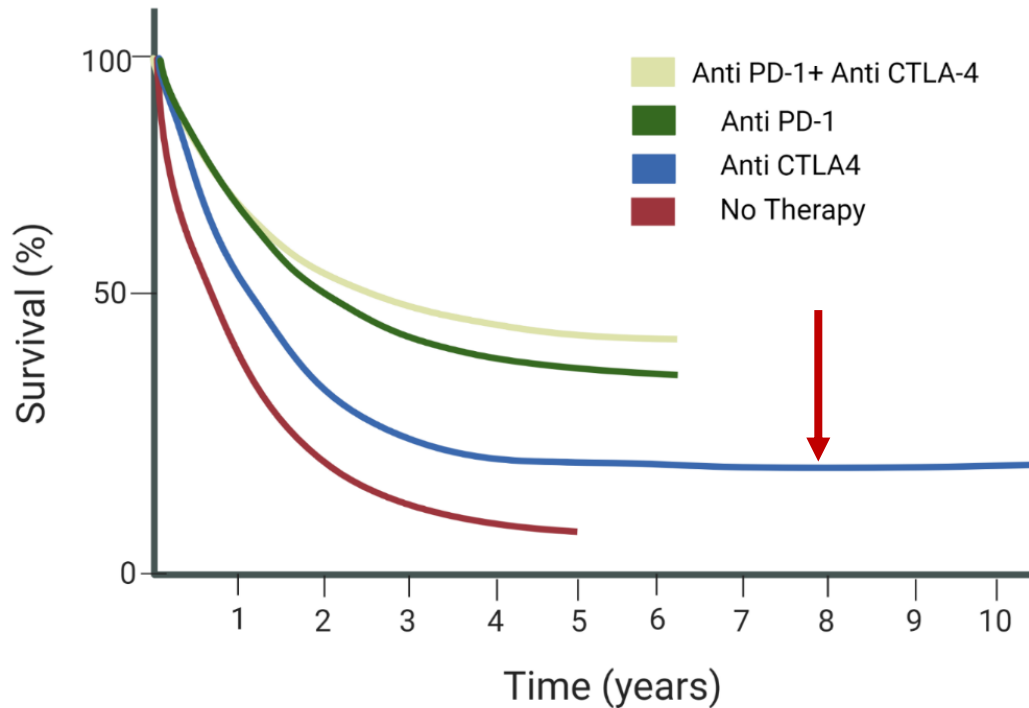
Combination with α CTLA-4:

■ Melanoma	>50%
■ Renal cell carcinoma	>40%

Reponse to immunotherapy – why the enthusiasm?



High percentage but
short-term benefit



Moderate percentage but
long-term benefit

Concept by G. Freeman, Harvard Medical School
Curves are hand-drawn with Biorender for didactic purposes, do not necessarily represent real results from clinical trials

Responses to immunotherapy can...

...develop fast

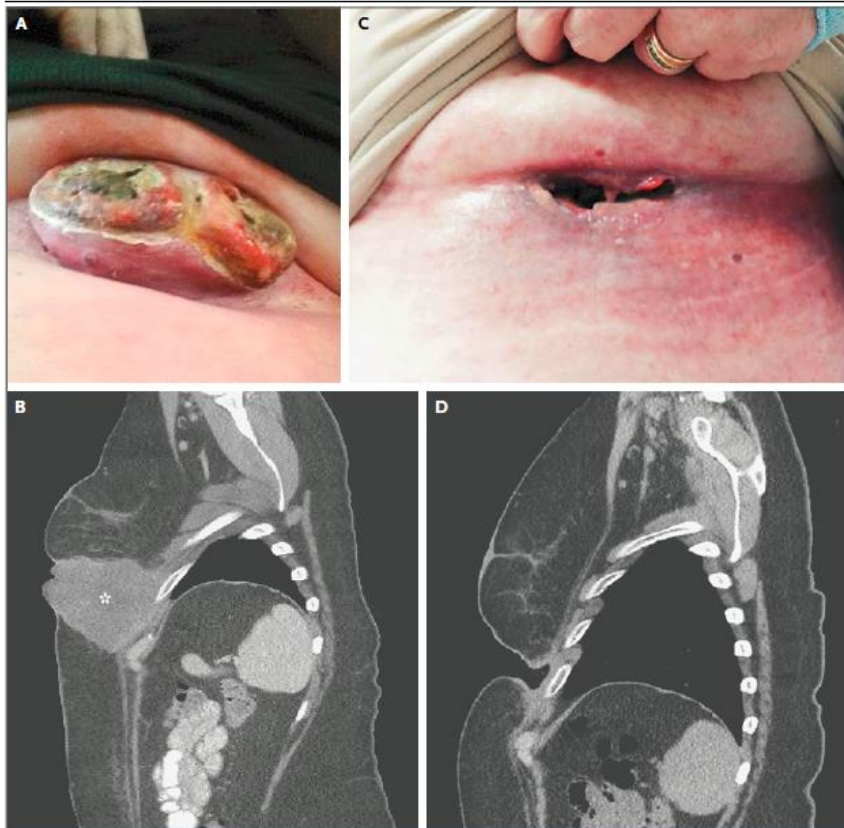
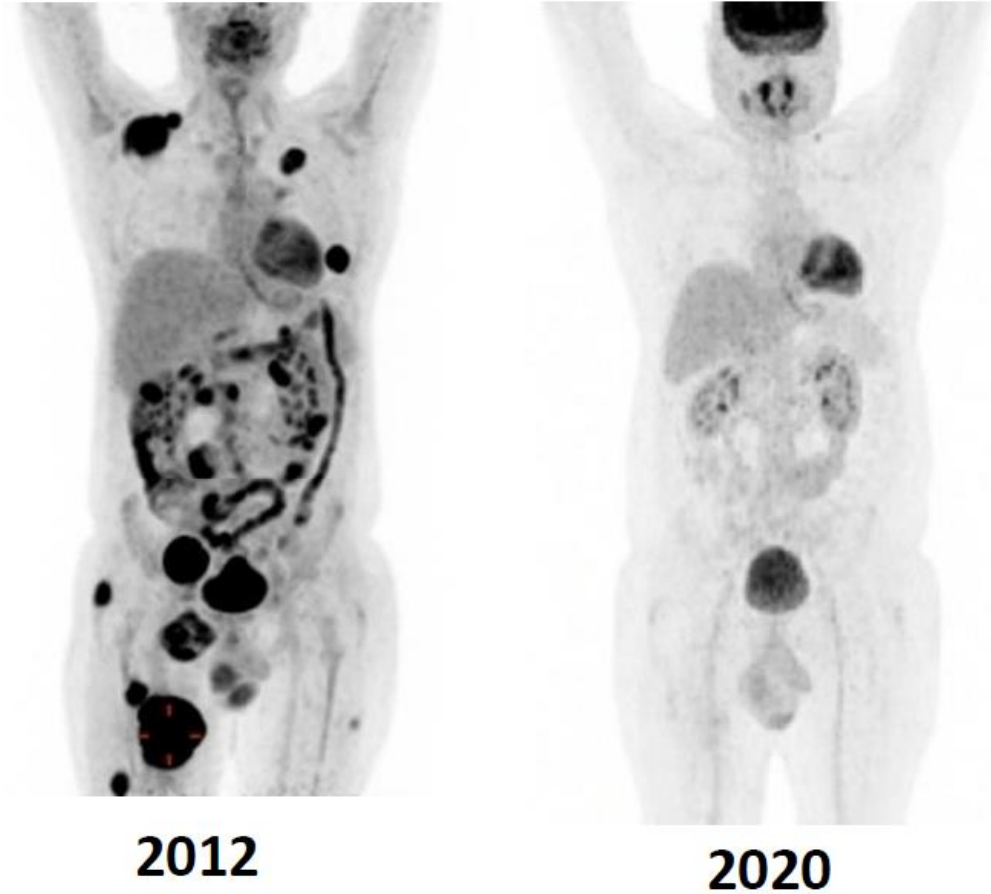


Figure 1. Response of a Large Chest-Wall Melanoma Metastasis to One Dose of Ipilimumab plus Nivolumab.

A pretreatment photograph (with the camera pointing upward from the patient's waist) (Panel A) and a pretreatment CT scan with soft-tissue windows (Panel B) show the chest-wall mass (asterisk). Three weeks after the first treatment, the tumor resolved, leaving a cavity (Panel C). Six weeks after the first treatment, a CT scan showed resolution of the chest-wall mass (Panel D).

... be long-lasting



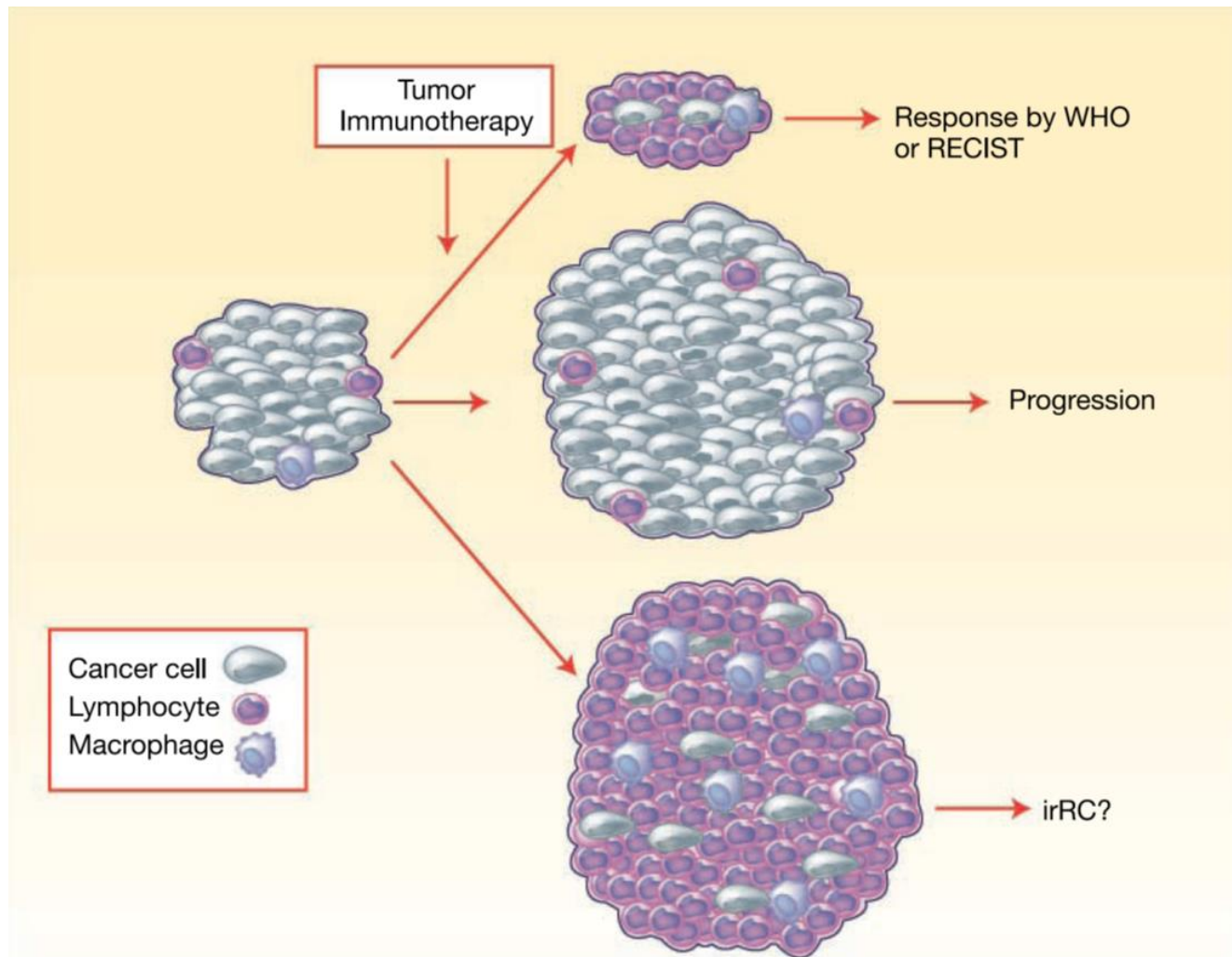
2012

2020

Updated from Andersen R, Donia M, Ellebaek E, et al. Clin Cancer Res. 2016. Response to TIL therapy.

This letter was published on April 20, 2015, at NEJM.org.

Response evaluation - pseudoprogression



Ribas A et al. Clin Cancer Res 2009

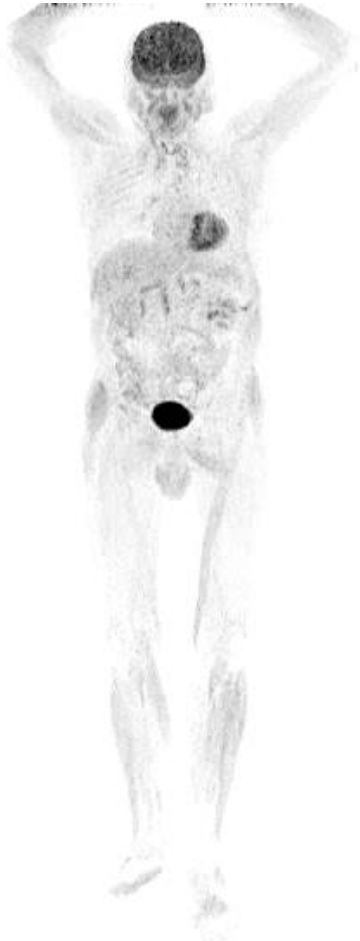
Pseudoprogression: A rare phenomenon which occurs in 1-10% of melanoma patients

Immune cells infiltrate the tumor, causing inflammation and swelling which can be mistaken for tumor growth

Pseudoprogression is most commonly seen within the first few months

Understanding pseudoprogression is crucial for clinicians to avoid prematurely discontinuing effective treatments

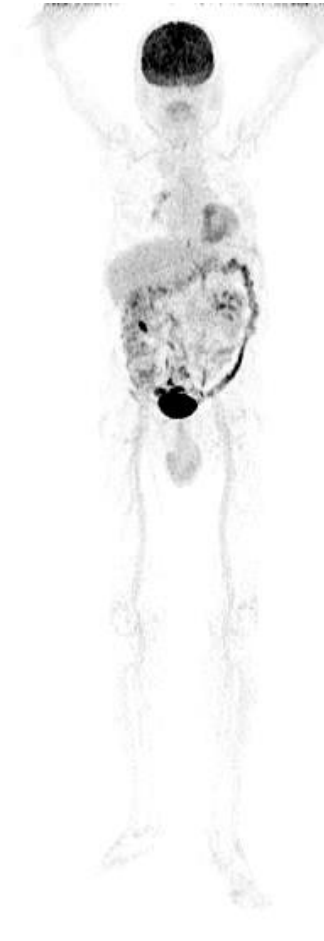
Peudoproggression Melanoma (metastatic disease)



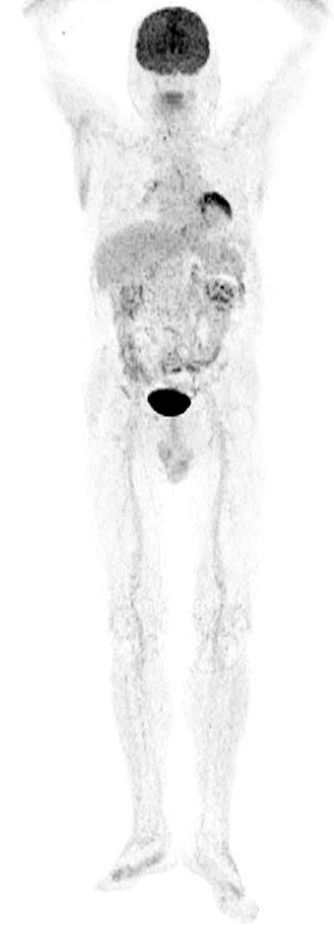
November 2017



January 2018



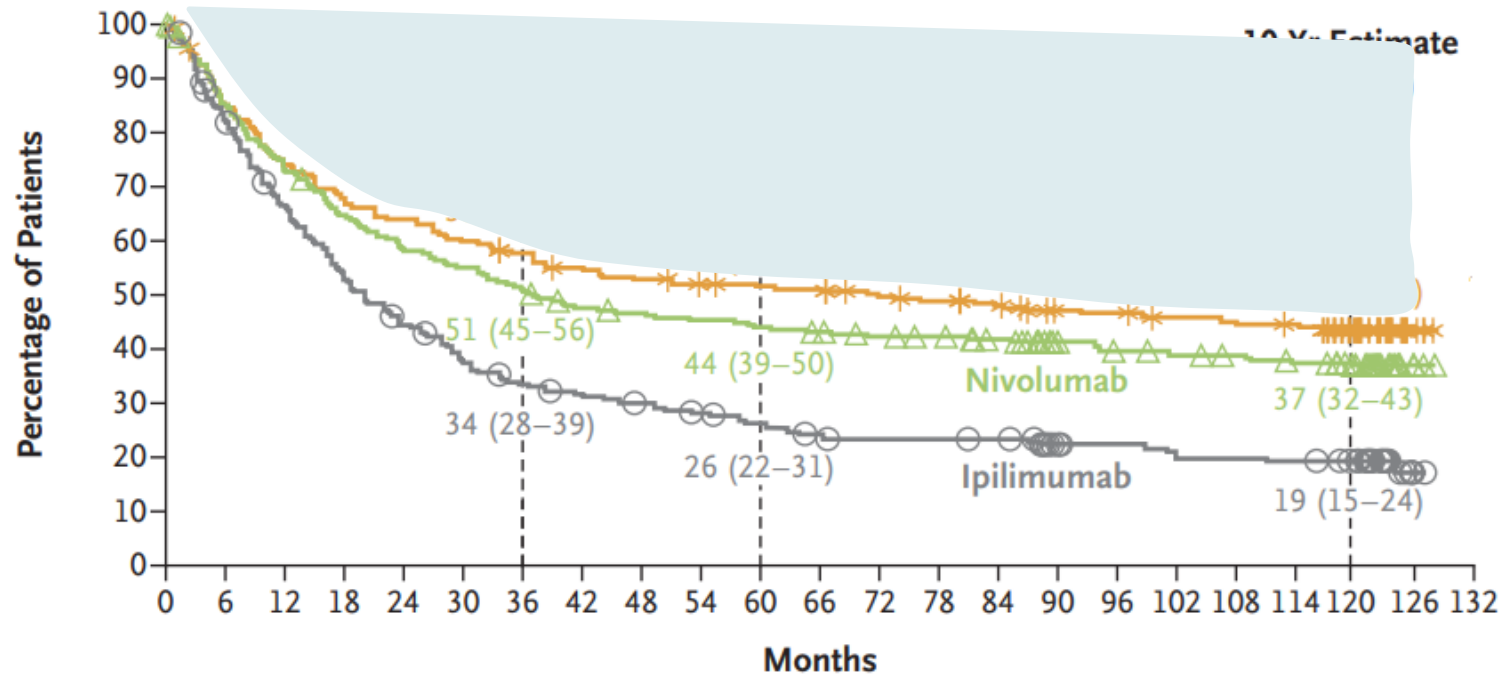
February 2018



March 2019

Immune Checkpoint Inhibitors – A revolution in the treatment of metastatic melanoma

Overall Survival



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Despite great advances in the treatment of metastatic melanoma

- ~ 35 % of melanoma patients show **primary resistance** to therapy
- ~ 60 % of melanoma patients progress within three years on combination ICI

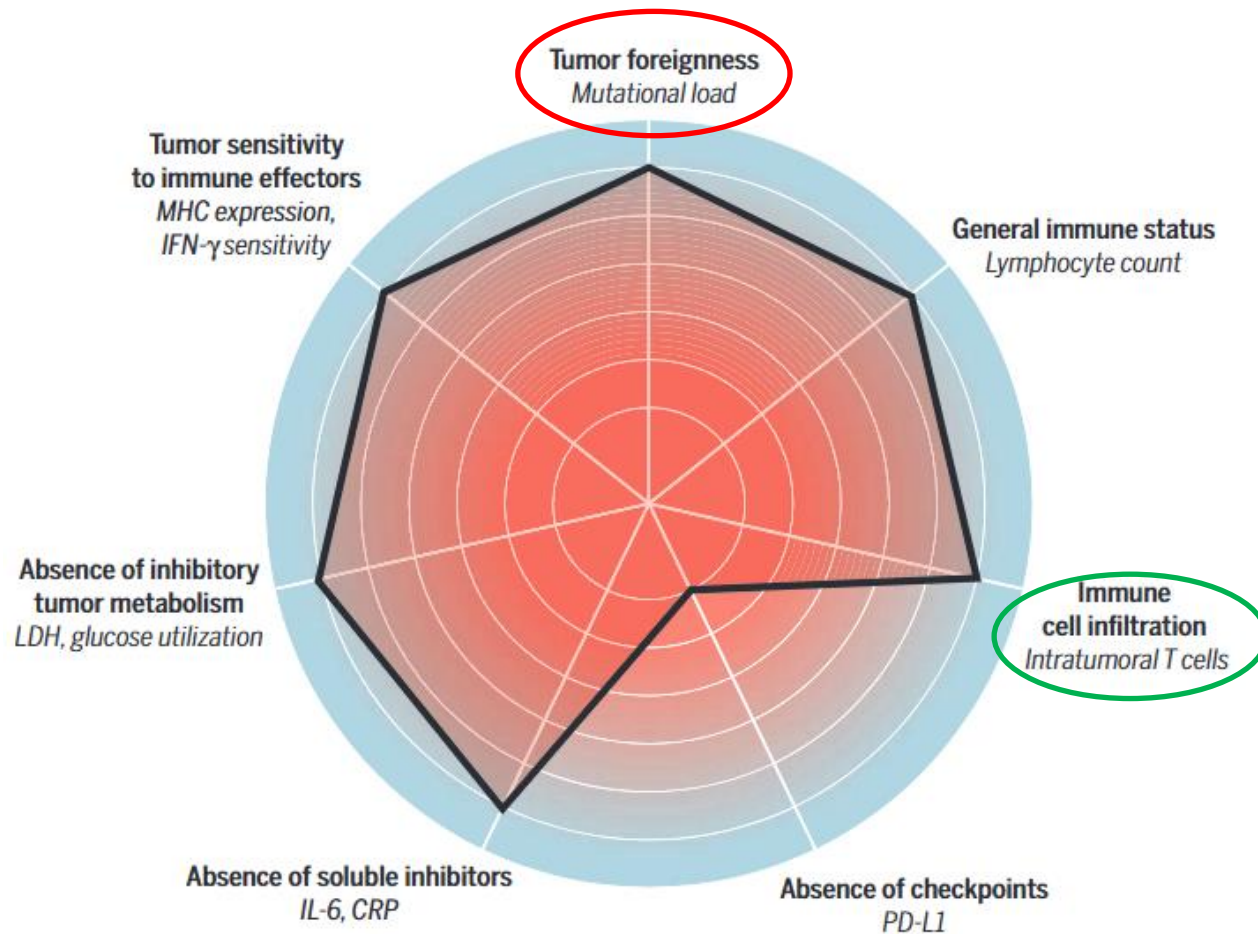
Wolchok et al., new England journal of med., 2024

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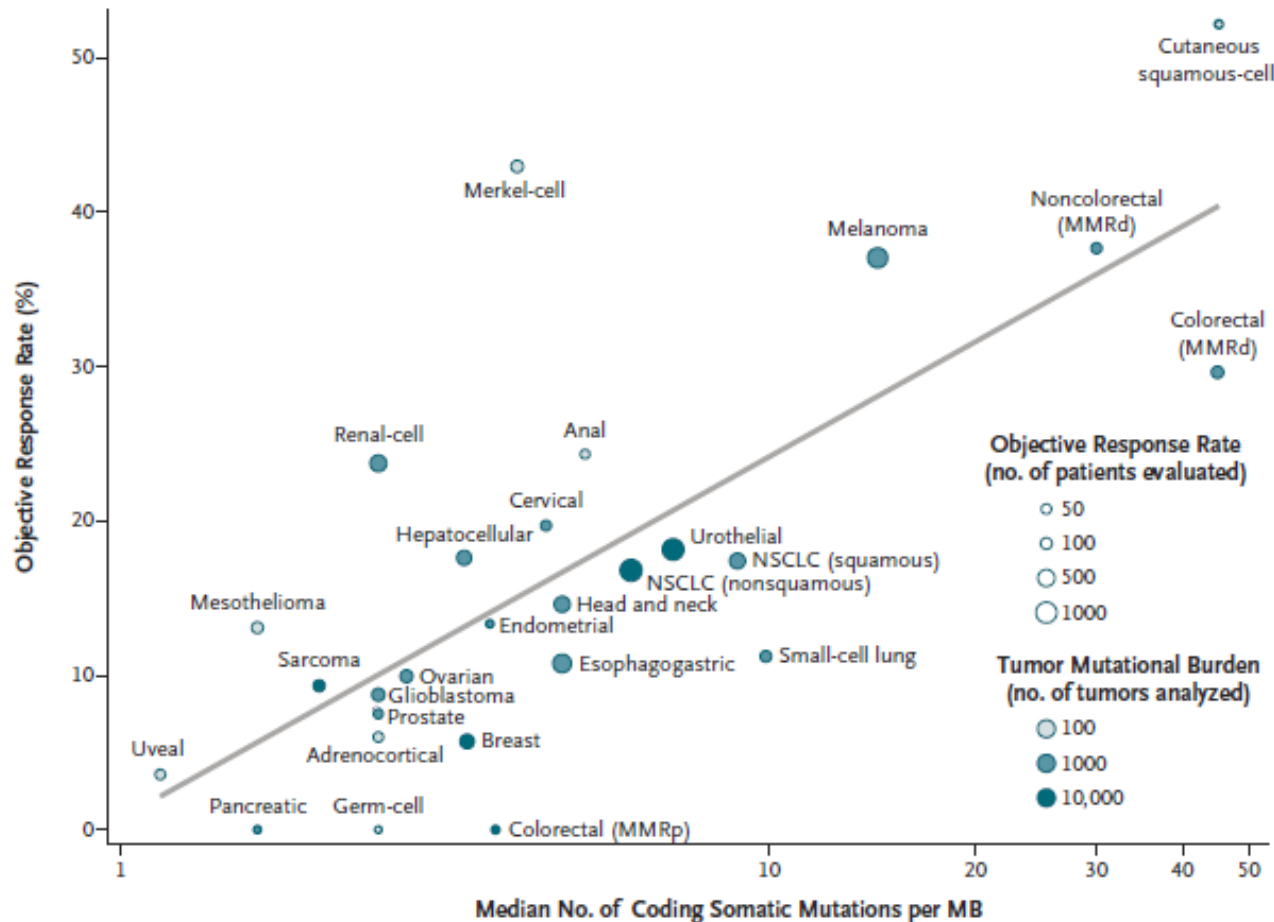
Tumor immunogenicity - The cancer immunogram

Which patients are most likely to benefit from immunotherapy?



- Seven parameter that provide a framework to understand the immunogenicity of a cancer
- The “value” of these parameters can differ greatly between diagnoses and patients

Correlation between tumor mutational burden (TMB) and objective response to anti-PD1/PDL1

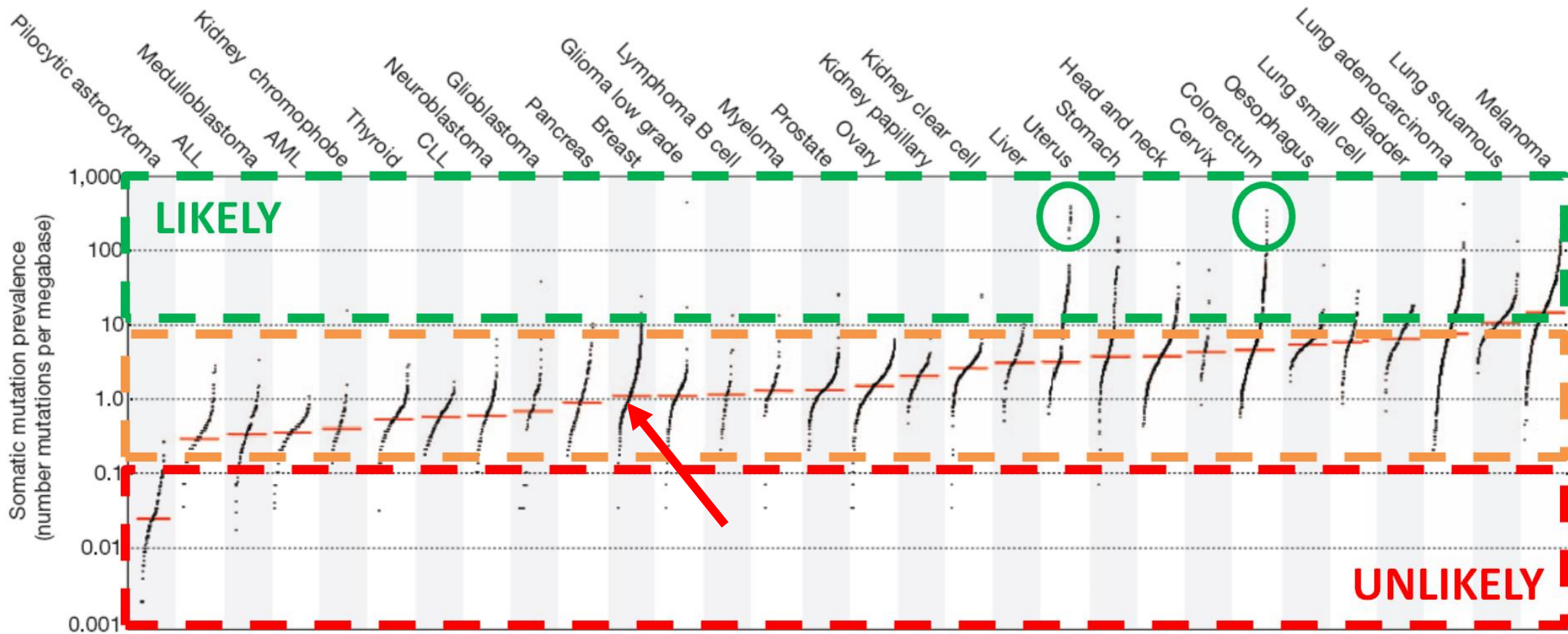


TMB is the number of somatic mutations in the coding DNA sequence of the cancer genome

TMB does not take into account self-antigen recognition

Yarchoan et al, NEJM 2017

Mutational burden of solid tumors



Schumacher et al. Science 2017

Alexandrov et al, Nature 2013

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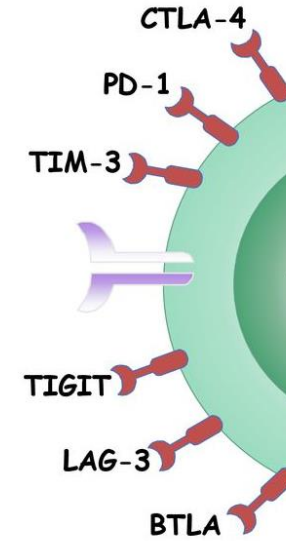
Manipulation of the immune system comes with a risk



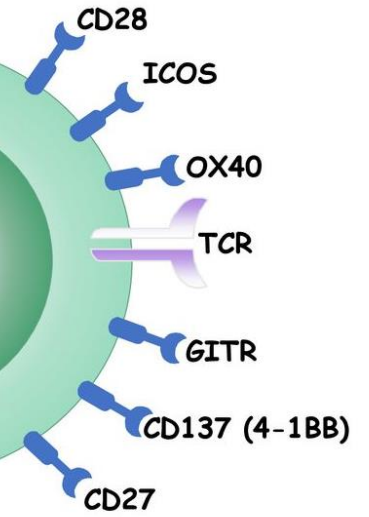
- Immunological balance:
 - Critical to maintain tolerance towards normal tissue
 - Prevents autoimmunity
- Immune regulating antibodies
 - Can potentially cause autoimmune reactions by interrupting the immune balance

→ Immune-related adverse events

Inhibitory receptors



Activating receptors (costimulators)



Infections



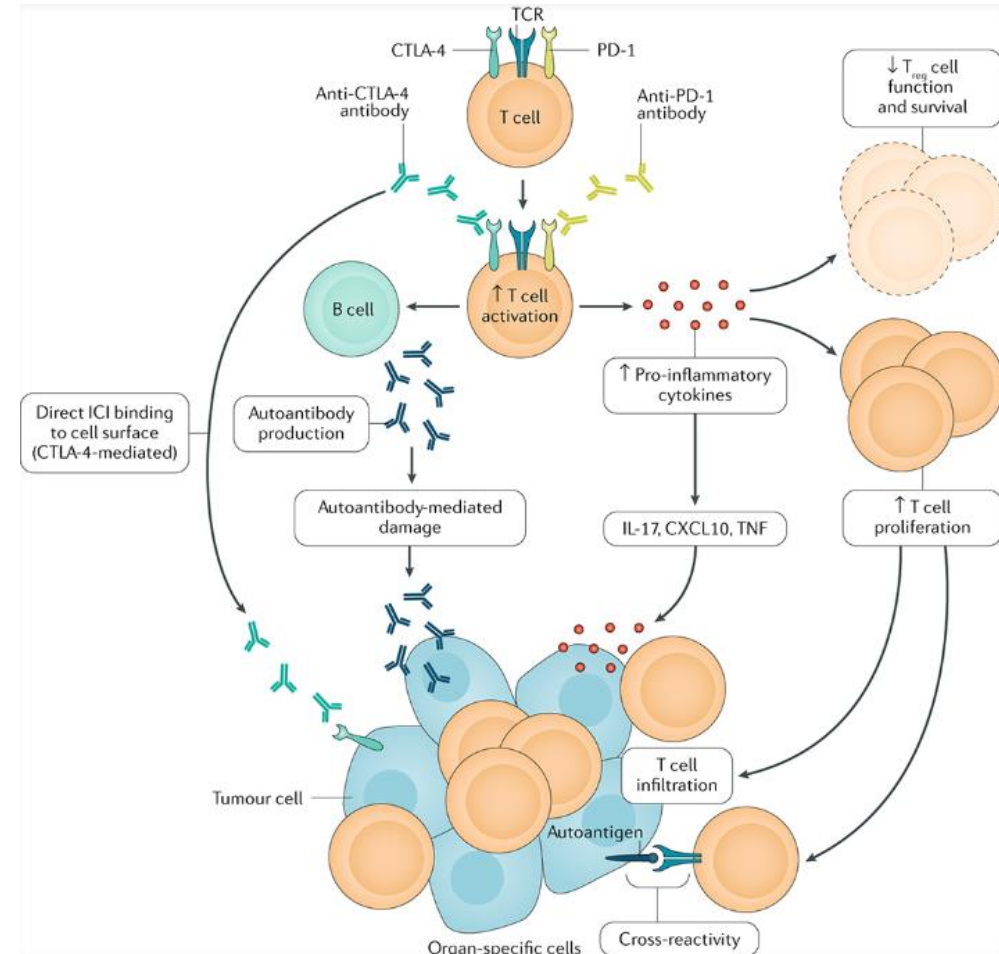
Autoimmune diseases



Immune-related Adverse Events (irAEs) – why?

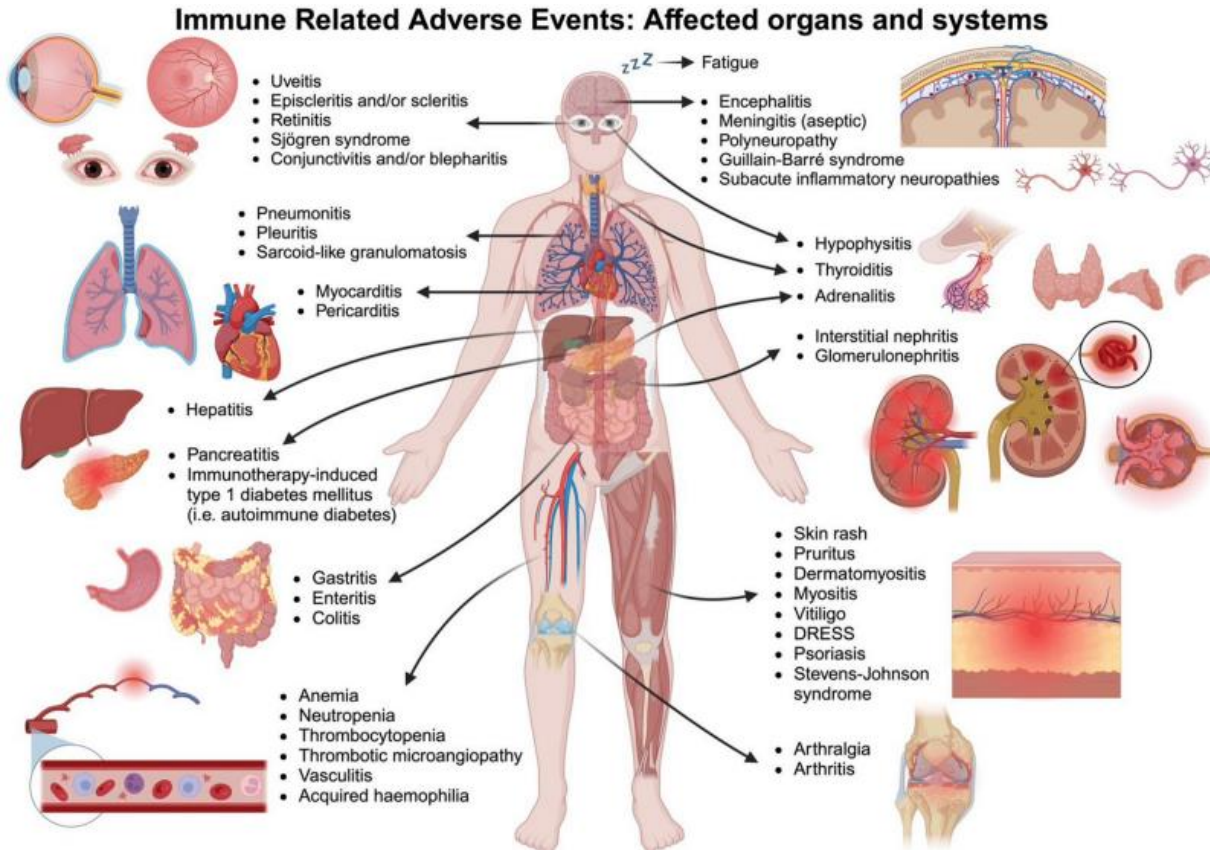
Potential mechanisms:

- 1) increasing T-cell activity against **overlapping antigens** in tumors and healthy tissue
- 2) increasing levels of preexisting **autoantibodies**
- 3) an increase in the level of **inflammatory cytokines**
- 4) enhanced **complement-mediated inflammation** due to direct binding of drug antibody against immune checkpoint molecules (e.g. CTLA-4) expressed on normal tissue
- 5) **Genetic susceptibility** to Immunotox may also play an important role but has so far been poorly studied

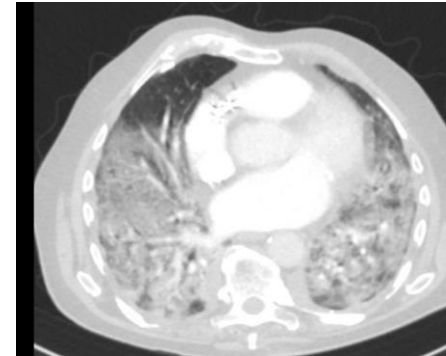


Ramos-Casals et. al., Nature Rev Dis Primers 2020

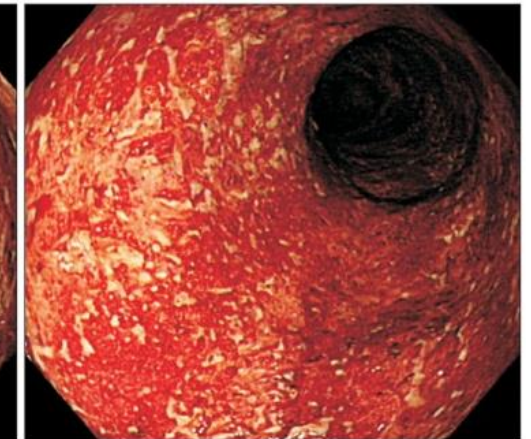
Immune-related Adverse Events – which?



- ICIs are well-tolerated by most people
- irAEs are often mild, but they can be fatal
- Common irAEs are rash, colitis, endocrinopathies, and pneumonitis



Okiyama et al., Allergy Int., 2022



Lee et al., Intestinal Research 2018

Immune-related Adverse Events – which?

- Mild irAEs are most often seen, while serious irAEs are less common.

CTCAE-grading

Grade 1: Mild; asymptomatic; clinical or diagnostic observations only; intervention not indicated.

Grade 2: Moderate; minimal, local or noninvasive intervention indicated; limiting age-appropriate instrumental ADL

Grade 3: Severe or medically significant but not immediately life-threatening; hospitalization or prolongation of hospitalization; limiting self-care ADL.

Grade 4: Life-threatening consequences; urgent intervention indicated.

Grade 5: Death

Common Terminology Criteria of Adverse Events

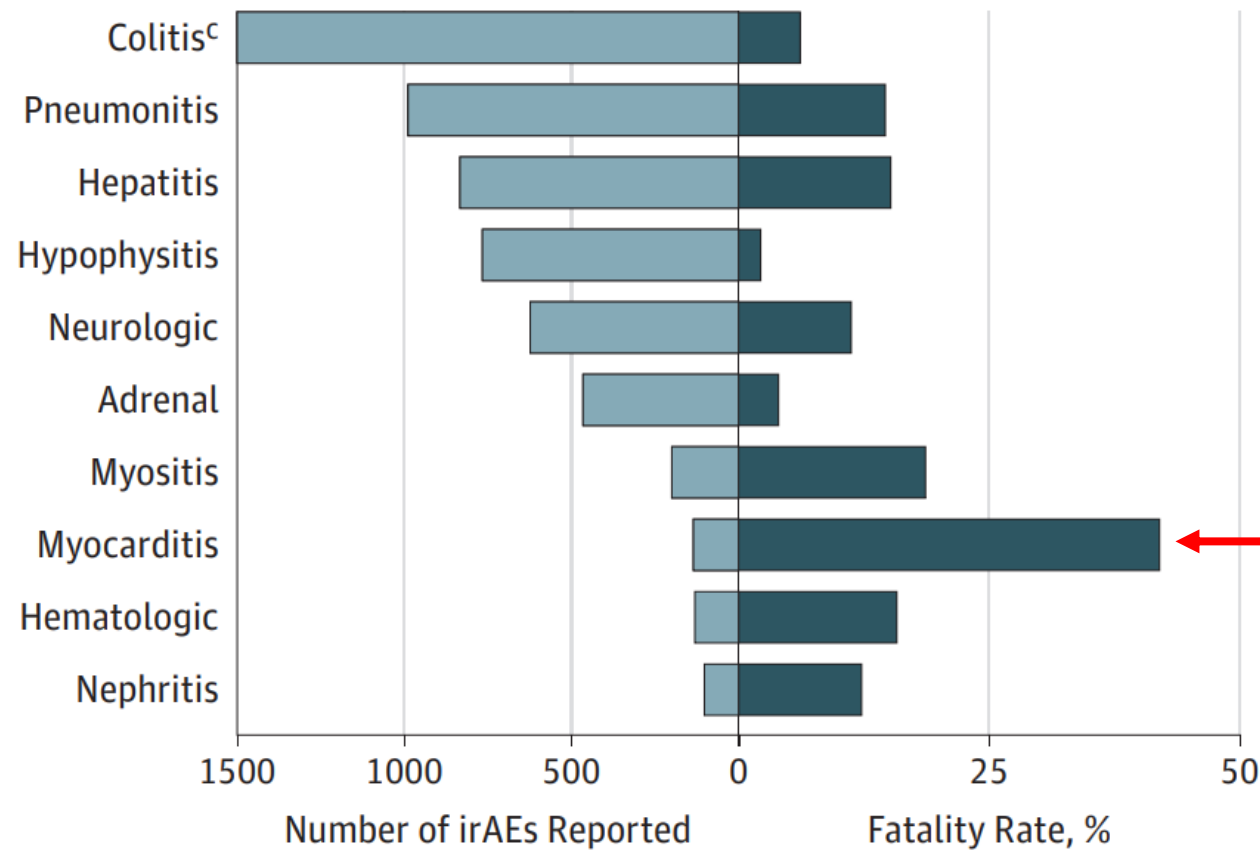
The type and severity of irAEs differ between the various antibodies

	Grade 3-4 AEs %	% of Pts who permanently discontinued for any grade
Ipilimumab 3 mg/kg ¹	27	15.4
Ipilimumab 10 mg/kg ¹	34	31
Nivolumab ²	13	6
Pembrolizumab 2 mg/kg ³	13.5	4.5
Ipilimumab/Nivolumab ⁴	56.5	38.7

Modified from Ascierto P, ESMO 2017 Annual Meeting

Incidence and fatality rate of immune related adverse events

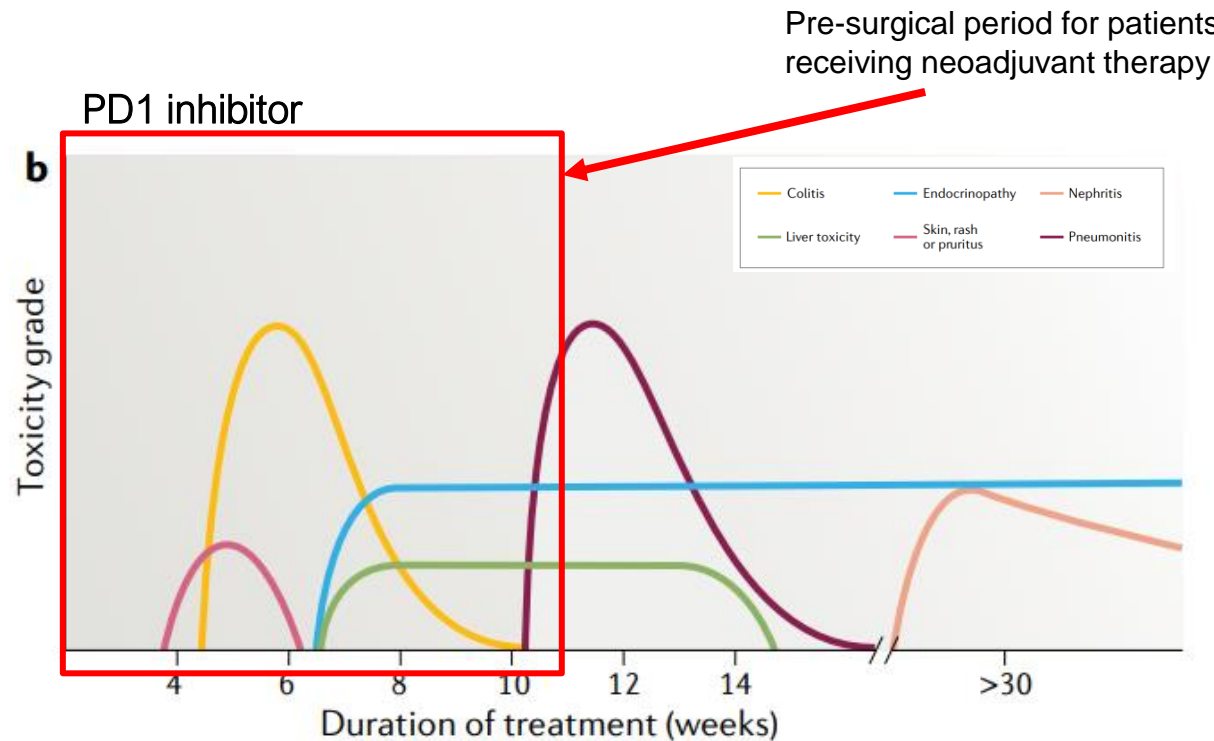
C Cases and fatality rates



- Uncommon (<1%), but may be life-threatening (up to 50%)
- Highest incidence and fatality with combination treatment
- Median onset 1 month after therapy initiation

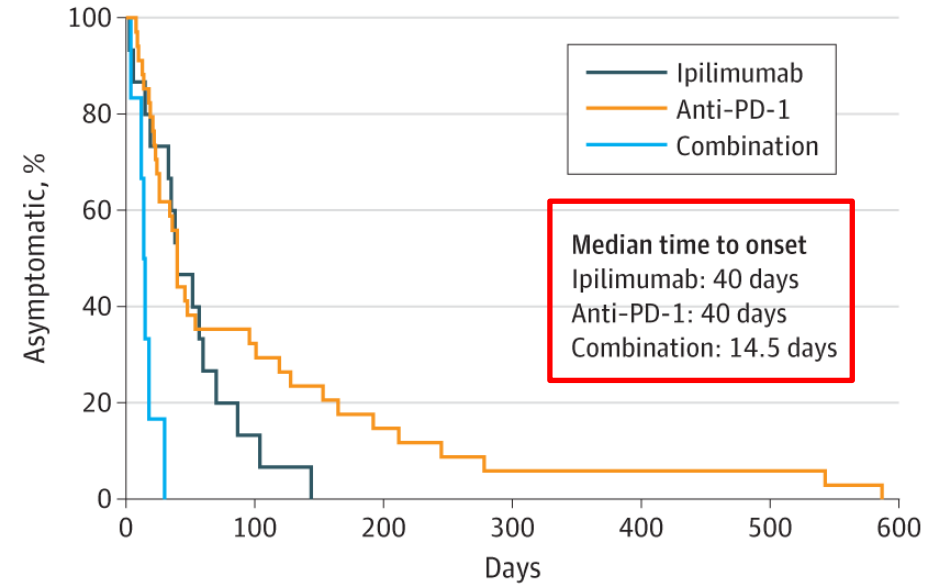
Wang et al., JAMA Oncology 2018

Immune-related Adverse Events – when?



Martins et al., Clinical Oncology 2019

- Many irAEs develop within the first **4-12 weeks** from treatment initiation
- The onset is earlier for patients receiving combination therapy.
- irAEs that tend to develop late (>1 year): Kidney and haematological

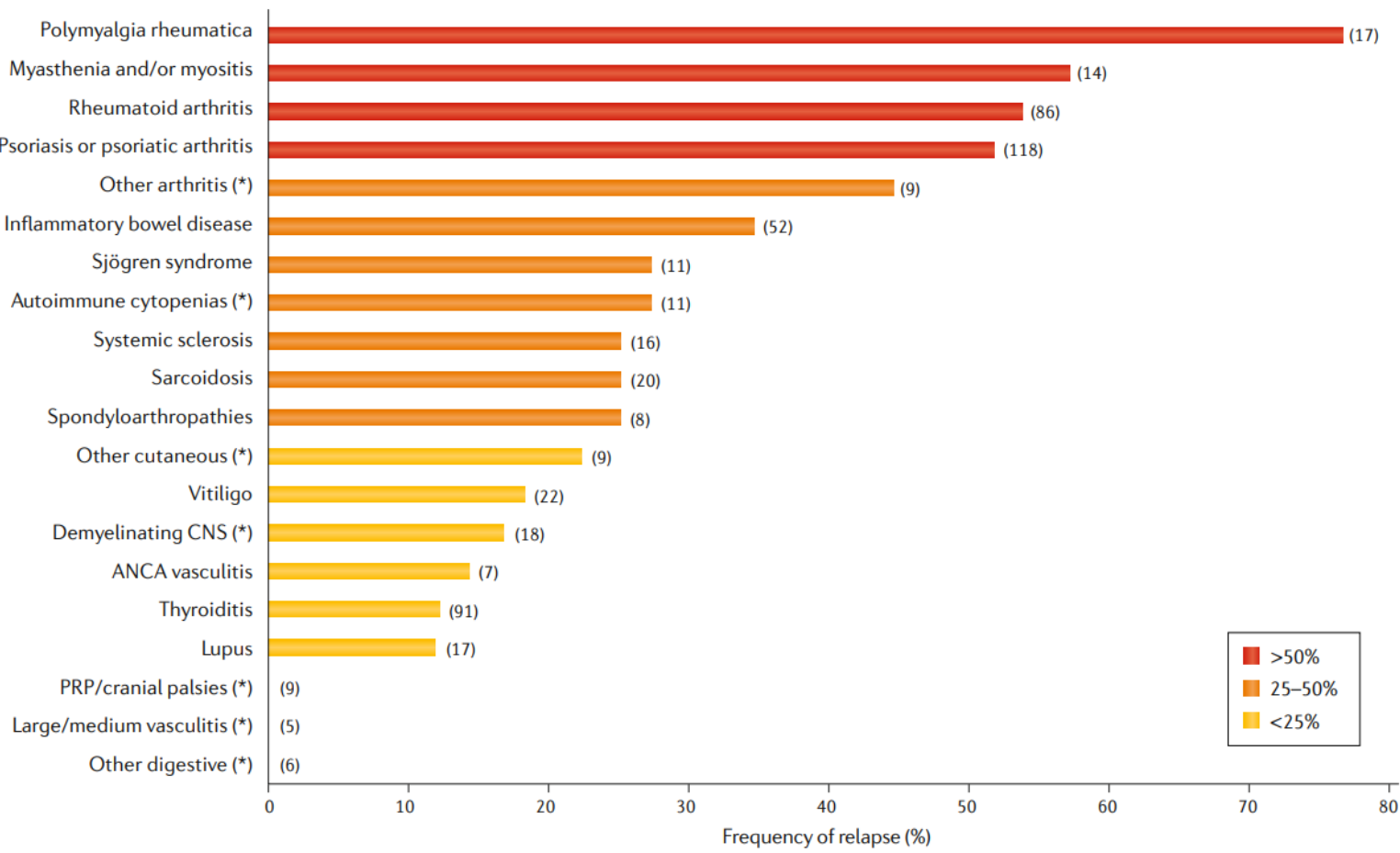


No. at risk							
Ipilimumab	15	2	0	0	0	0	0
Anti-PD-1	34	11	5	2	2	2	0
Combination	6	0	0	0	0	0	0

Wang et al. JAMA onc. 2018,

Fatal irAEs develop early

Immune-related Adverse Events – who?

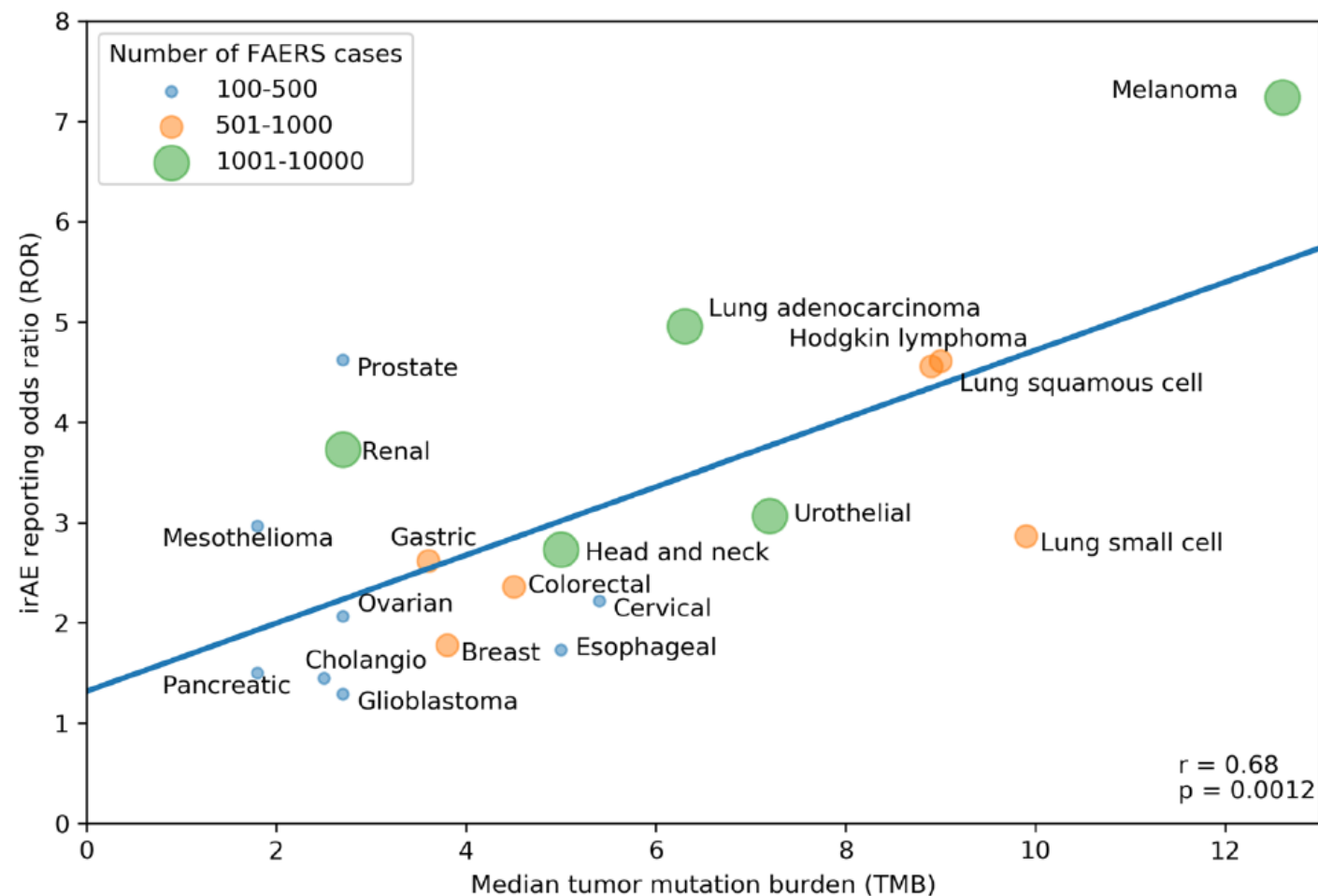


Ramos-Casals et al., Nature Rev Dis Primers 2020

Pre-existing autoimmune disease increases the risk of irAEs

~5% of the Danish population have an autoimmune disease

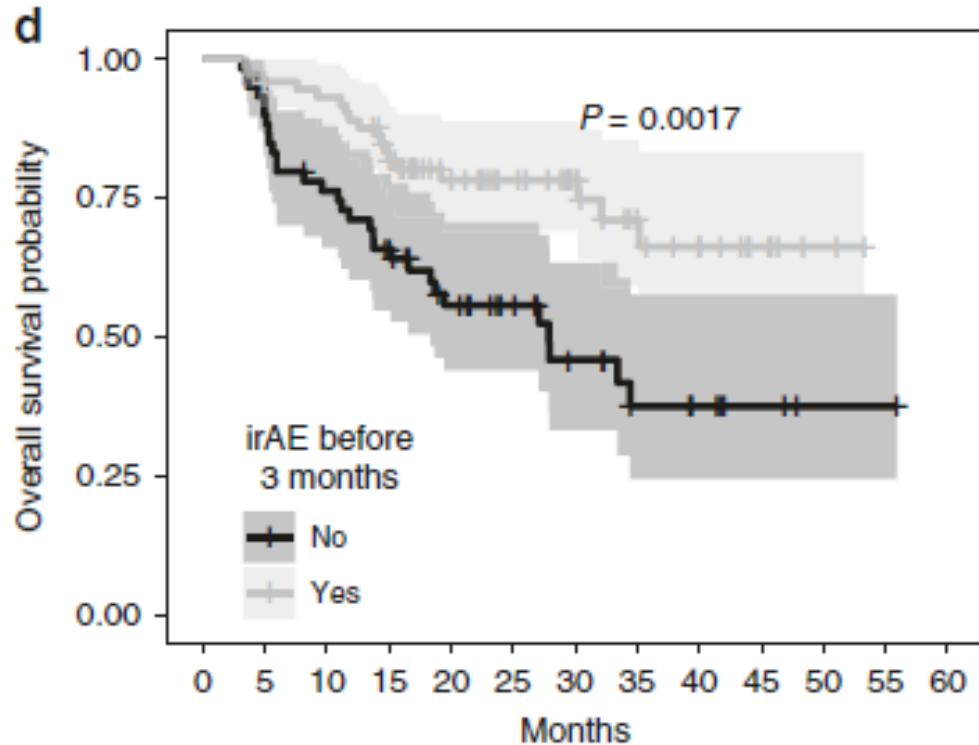
Immune-related Adverse Events – who?



Immune-related adverse events are associated to tumor mutational burden in different solid cancers

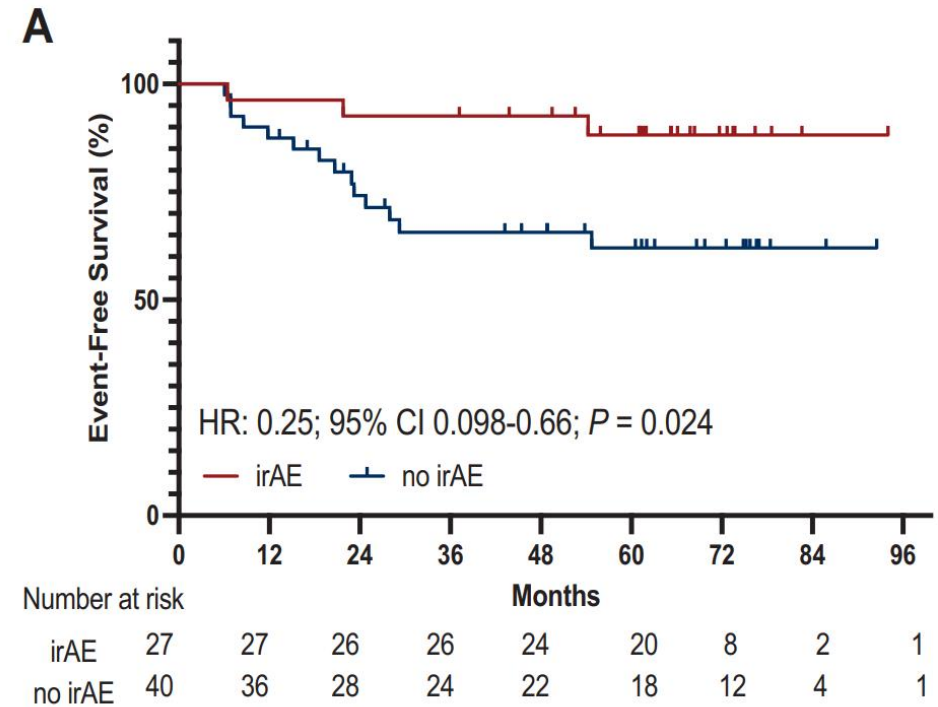
Cancer Immunology, Immunotherapy (2020)

Immune Related Adverse Events are Related to Survival in Melanoma Patients



British Journal of Cancer (2021)

Similar tendencies are reported in other solid cancers, including TNBC



Rios-Hoyo et al., ESMO open, 2025

The development of irAE is associated with a significantly higher EFS in patients with TNBC treated with neoadjuvant immune checkpoint therapy plus chemotherapy

Immune Related Adverse Events – increased risk in elderly?

Safety Summary by Key Subgroups (CheckMate 067)

Patients Reporting Event, %	NIVO+IPI (n=313)		NIVO (n=313)	
	Any Grade	Grade 3–4	Any Grade	Grade 3–4
Treatment-related AE	96	55	82	16
Aged ≥65 and <75 years	95	50	81	22
Aged ≥75 and <85 years	97	48	83	21
M1c disease	94	54	79	14
PD-L1 expression ≥5%	97	53	85	16
Patients with complete response	100	58	93	32
Treatment-related AE leading to discontinuation	36	29	8	5
Treatment-related death^a	0		<1	

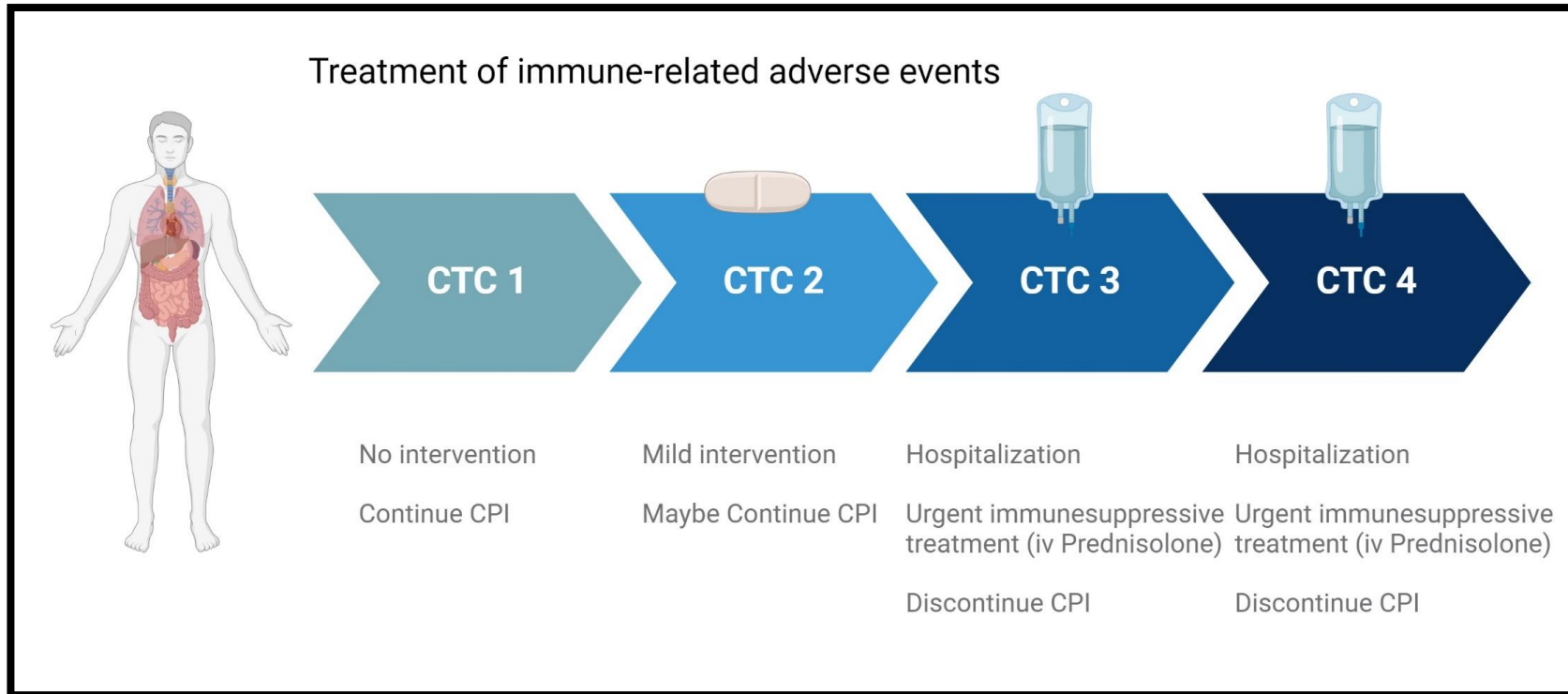
- Chance of efficacy largely independent of age (data not shown)
- The risk of serious side effects is not increased with increasing age
- The tolerability of side effects can be reduced
- In DK we rarely treat patients above 80 with **combined** checkpoint inhibitors.

- Treatment-related AEs reported with IPI were consistent with prior experience

^aOne death in the NIVO group was reported as neutropenia.
Larkin J, et al. Presented at ECC 2015 abstract 3303.

How to handle irAEs – Key recommendations

There should be a high level of suspicion that new symptoms are treatment-related

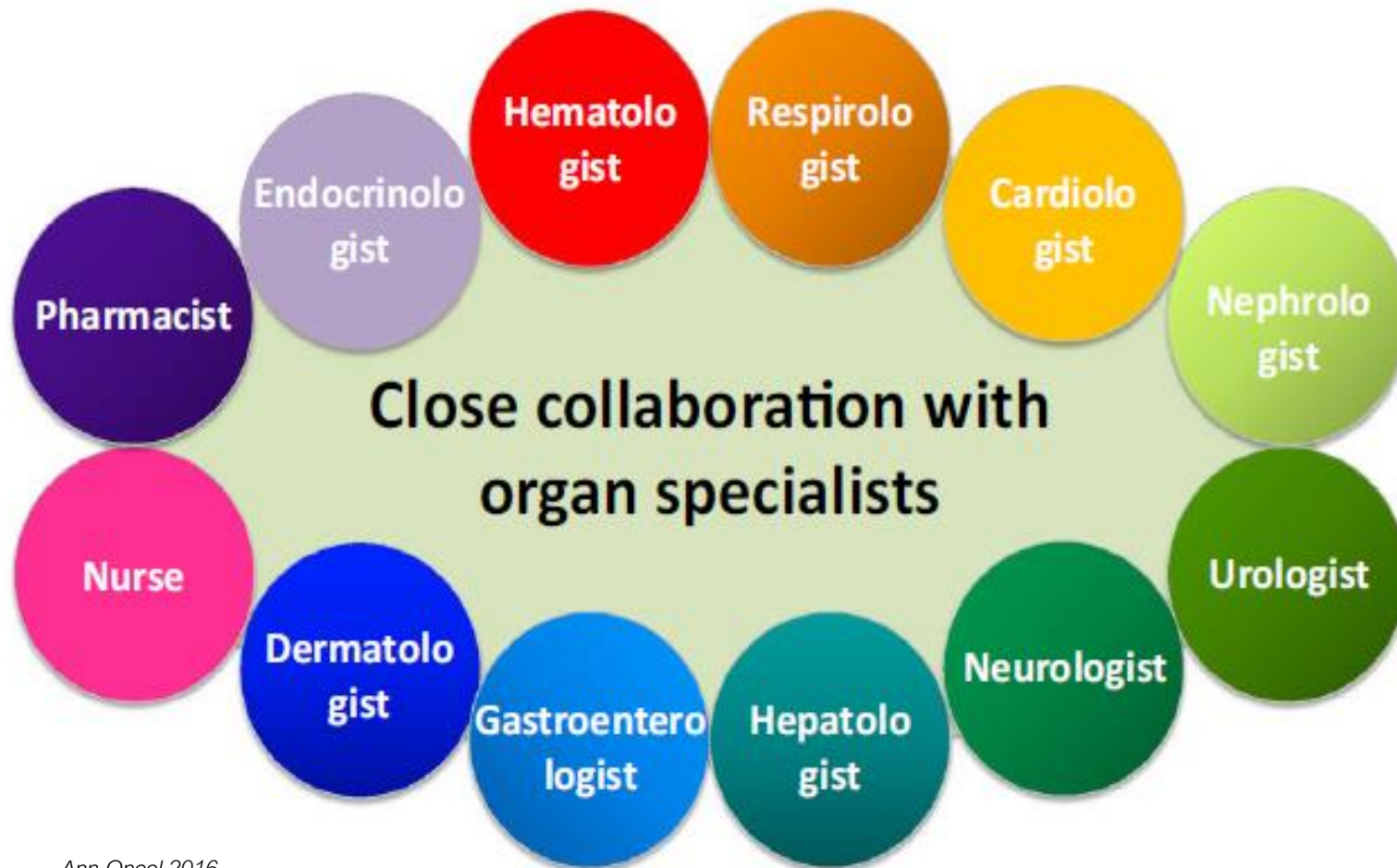


When symptoms and/or laboratory values revert \leq grade 1, rechallenging with ICIs may be offered

Grade 4 toxicities: Permanent discontinuation of ICIs (except for endocrinopathies)

R. Jurlander, created with Biorender

Multi-disciplinary management of immune toxicity

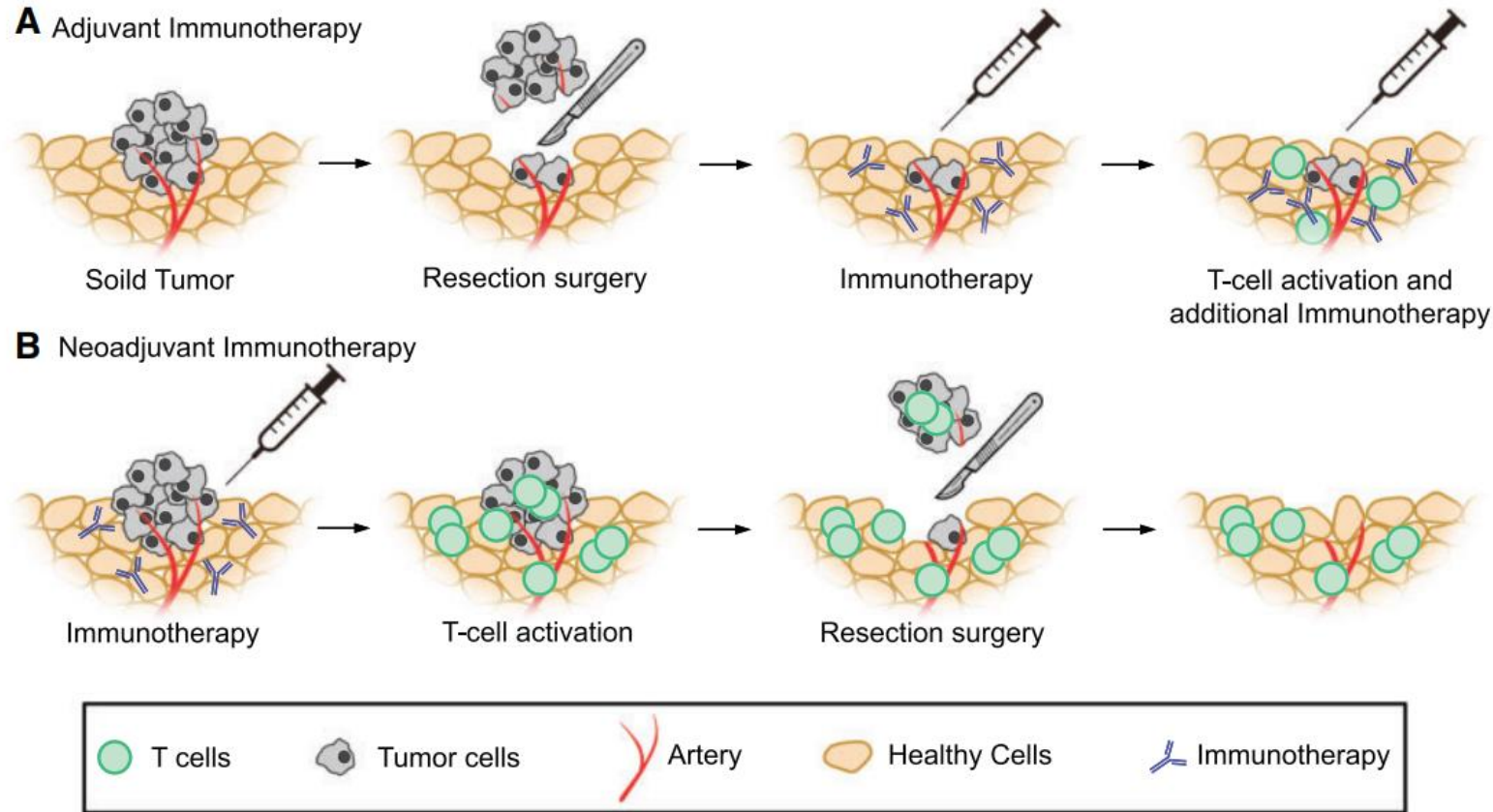


Ann Oncol 2016

Outline

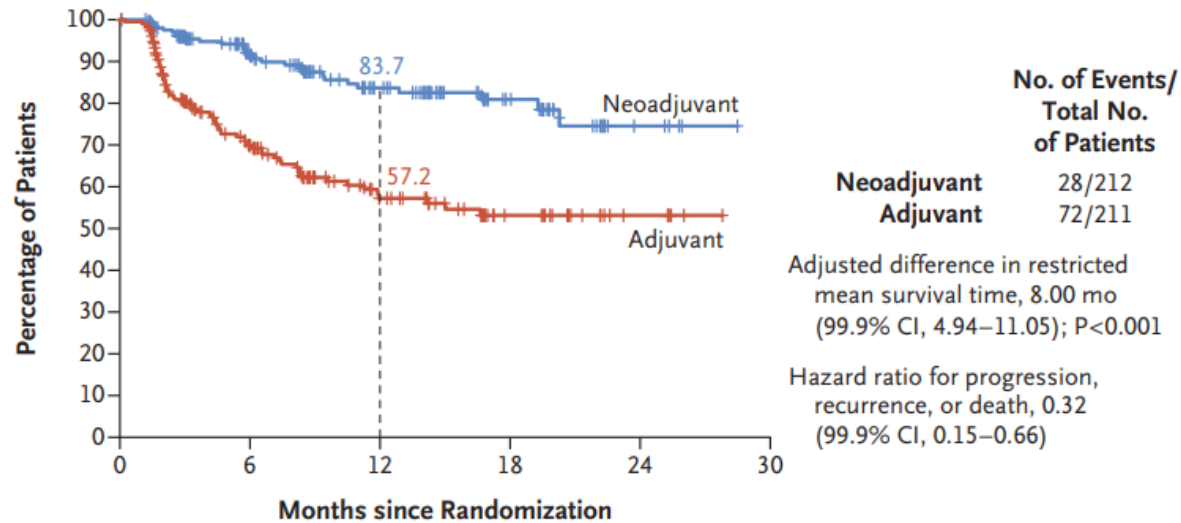
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- Perspectives

Neoadjuvant immunotherapy – theoretically better than adjuvant therapy



The presence of the entire tumor, and therefore the complete neoantigen repertoire, at the time the immunotherapy is initiated induces a stronger and more diverse T cell response

Neoadjuvant ICI results in a better EFS compared to adjuvant ICI in melanoma



No. at Risk (no. censored)

Neoadjuvant	212 (0)	126 (71)	77 (111)	34 (152)	5 (179)
Adjuvant	211 (0)	100 (57)	53 (89)	23 (116)	6 (133)

Blank et al, New eng. J. Med., 2024

Table 3. Adverse Events.*

Event	Neoadjuvant Group (N=212)	Adjuvant Group (N=208)
Any adverse event — no. (%)	204 (96.2)	194 (93.3)
Any grade ≥ 3 adverse event — no. (%)	100 (47.2)	71 (34.1)
Serious adverse event — no. (%)	77 (36.3)	49 (23.6)
Treatment-related adverse event — no. (%)	196 (92.5)	178 (85.6)
Treatment-related grade ≥ 3 adverse event — no. (%)	82 (38.7)	50 (24.0)
Surgery-related adverse event — no./total no. (%)	120/198 (60.6)	151/208 (72.6)
Surgery-related grade ≥ 3 adverse event — no./total no. (%)	28/198 (14.1)	30/208 (14.4)
Adverse event related to systemic treatment — no./total no. (%)	181/212 (85.4)	123/170 (72.4)
Grade ≥ 3 adverse event related to systemic treatment — no./total no. (%)	63/212 (29.7)	25/170 (14.7)
Discontinuation of treatment due to adverse event — no. (%)	19 (9.0)	30 (14.4)
Death due to treatment-related adverse event — no. (%)	0	1 (0.5)

Neoadjuvant immunotherapy in melanoma

- Does not increase the rate of surgery-related adverse events
- Does not increase the duration of the surgery
- Does not increase specific morbidities (seroma, lymphodema ect.)

Kuijpers et al., Cancers, 2024

Most trials does not include specific surgical endpoints

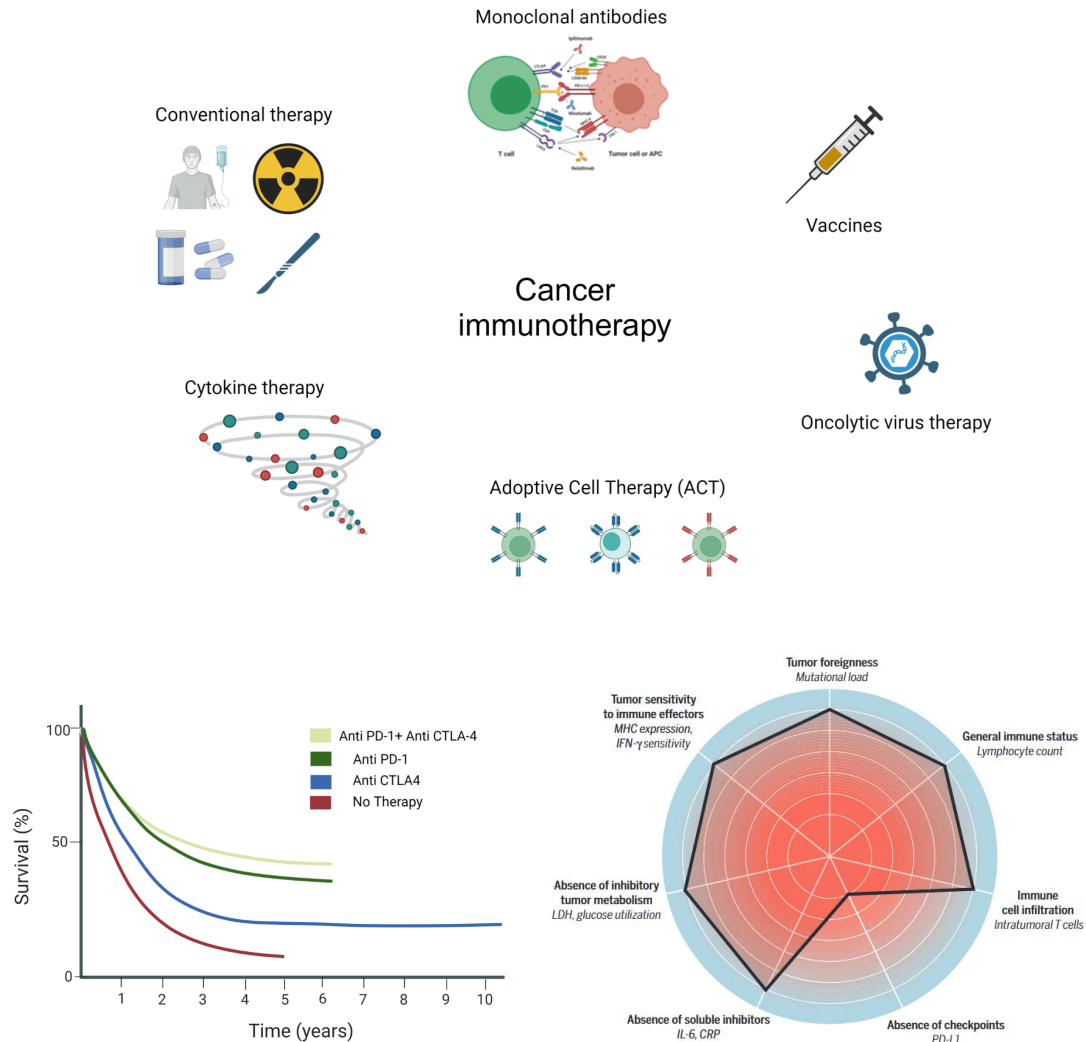
- Tissue fibrosis and its impact on surgery (only anecdotal reports)?
- Difficulties in accurate determination of tumour margins?

Kuijpers et al., Cancers, 2024, Leser et al., Ann. Of surgery, 2024

Outline

- Introduction: Cancer Immunotherapy
 - Rationale and historical development
 - Types of immunotherapy
- Immune Checkpoint Inhibitors (ICI)
 - Mode of action and efficacy in and beyond malignant melanoma
 - Immune related toxicity: why, which, when and who?
- Neoadjuvant immunotherapy – rationale and status
- Perspectives and take-home-messages

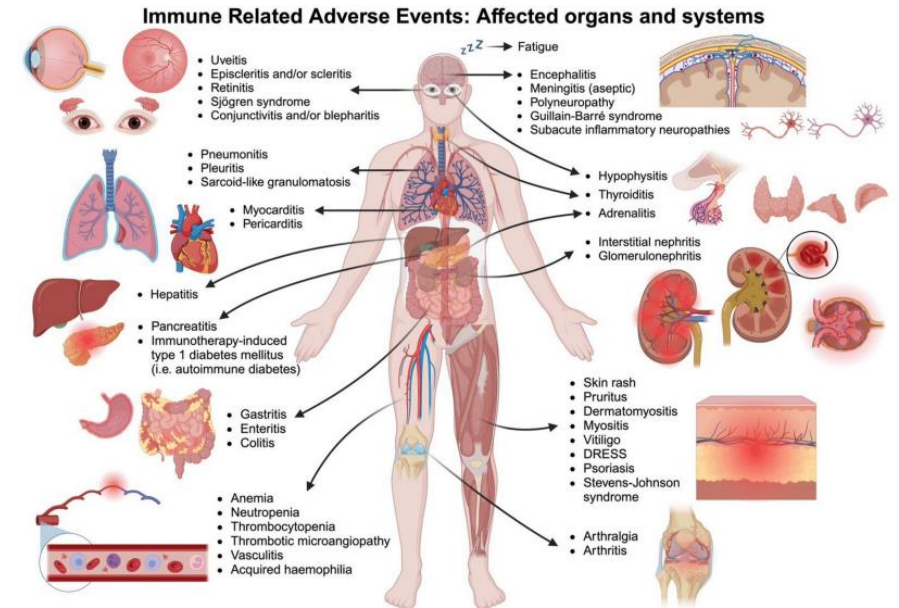
Immunotherapy – take home messages



- The term immunotherapy covers a wide range of immune-activating approaches, with immune checkpoint inhibitors (ICIs) being the most widely used
- Immunotherapy continues to expand to an increasing number of solid tumor types
- Immunotherapy can result in durable, complete responses or long-lasting partial responses/stable disease, however primary and secondary resistance is a major challenge
- Pseudoprogression is a rare phenomenon – but to understand and recognize it is important
- The chance of response depends on multiple factors (of which many are still not clear)

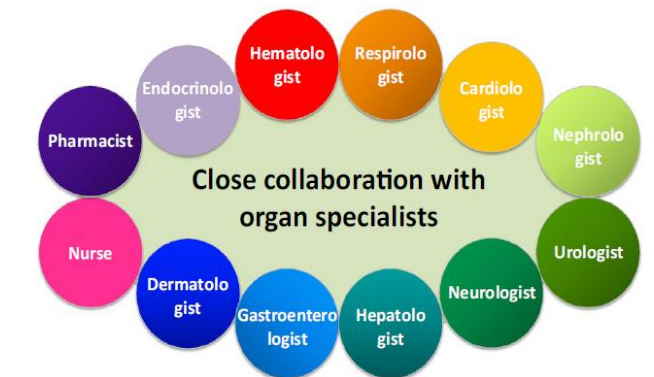
Immunotherapy – take home messages

- Immune-related adverse events can affect almost any organ system
- Most immune-related adverse events develop early, but late onset (>1 year) is possible
- Immune-related adverse events can be fatal. Early recognition and treatment is crucial
- Handling of severe irAEs is a multidisciplinary task
- Immunotherapy is expanding to the neoadjuvant setting (melanoma, TNBC)
demanding close collaboration with surgeons. The impact on surgical endpoints still needs further exploration.



Session A, May 13, auditorium G206-145

09.30-10.00	Registration, coffee and exhibition
10.00-10.15	Welcome Peer Christiansen
10.15-12.00	Immunotherapy for patients with breast cancer Moderators: Niels Kroman and Hanne Melgaard Nielsen
10.15-10.55	Experiences with immunotherapy from Denmark Tine Monberg
10.55-11.15	Indication for immunotherapy in breast cancer patients Christina Bjerre
11.15-11.35	Sygepleje til patienter med brystkræft der får immunterapi Karen Henneberg
11.35-12.00	Panel discussion



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Questions?

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