Pharmacology Update

Pharmacology Update 2016

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Disclosures

No conflicts to disclose

Objectives

• Identify new drugs that were FDA approved for cancer treatment in 2015/2016.

• Recognize how new drugs are given generic names.

• Identify how to gain information about new drugs based on the generic naming system
Progress in Cancer Therapy 2015/2016

17 new drugs gained FDA approval in 2015; 13 for solid tumors with 13 drugs getting expanded indications in solid tumors in 2015/16

- Non-small cell lung cancer
  - alectinib (ALK positive)
  - gefitinib (EGFR positive)
  - osimertinib (EGFR T790m positive)
  - necitumumab (squamous only)
- nivolumab (progressed on or after platinum-based tx)
- pembrolizumab (metastatic with PD-L1 expression)
- crizotinib (metastatic with ROS1–positive tumors)

Breast
- palbociclib (with letrozole first line ER+/HER2–)
- palbociclib (with fulvestrant for pretreated pts ER+/HER2–)

Colorectal
- trifluradine tipiracil
- ramucirumab (combination with FOLFIRI)

Pancreatic
- irinotecan liposomal

Melanoma
- cobimetinib in combination with vemurafenib for unresectable/metastatic BRAF v600e or v600k mutation positive
- talimogene laherparepvec (TVEC) unresectable cutaneous, subcutaneous and nodal lesions
- pembrolizumab (now for initial use and pts with prior treatment unresectable/metastatic)
- trametinib and dabrafenib (combination for metastatic BRAF v600e or v600k mutation positive)
- ipilimumab (adjuvant with at least one node positive and resected)
- ipilimumab and nivolumab (combination in BRAF wild type unresectable/metastatic)

http://www.fda.gov/Drugs/InformationOnDrugs/ApprovedDrugs/ucm279174.htm
Progress in Cancer Therapy 2015/2016

17 new drugs gained FDA approval in 2015; 13 for solid tumors with 13 drugs getting 10 expanded indications in solid tumors in 2015/16

- Thyroid
  - Lenvatinib
- Basal cell
  - Sonidegib
- Neuroblastoma
  - Dinutuximab

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Progress in Cancer Therapy 2015/2016

17 new drugs gained FDA approval in 2015; 13 for solid tumors with 13 drugs getting 10 expanded indications in solid tumors in 2015/16

- Sarcoma
  - Trabectedin (liposarcoma or leiomyosarcoma)
  - Erbubulin (liposarcoma)
- Neuroendocrine of GI or lung origin
  - Everolimus
- Renal cell
  - Nivolumab expanded indication for RCC after anti-angiogenic therapy

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Progress in Cancer Therapy 2015/2016

17 new drugs gained FDA approval in 2015; 13 for solid tumors with 13 drugs getting 10 expanded indications in solid tumors in 2015/16

- Non-Hodgkin follicular lymphoma
  - Obinutuzumab
- Hodgkin lymphoma
  - Brentuximab vedotin / post autologous HSCT consolidation
- Chronic lymphocytic leukemia
  - Ibrutinib
  - Ofatumumab (2nd and 3rd indications for CLL)
- Waldenstroms macroglobulinemia
  - Ibrutinib

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http://www.fda.gov/Drugs/InformationOnDrugs/ApprovedDrugs/ucm279174.htm
Progress in Cancer Therapy
2015/2016

17 new drugs gained FDA approval in 2015; 4 for hematologic malignancies
With 6 drugs getting 1 expanded indications in hematologic malignancies in 2015/16

- Multiple myeloma
  - elotuzumab
  - ixazomib
  - daratumumab
  - panobinostat
- carfilzomib (combination with lenalidomide and dexamethasone)

http://www.fda.gov/Drugs/InformationOnDrugs/ApprovedDrugs/ucm279174.htm

Progress in Cancer Therapy
2015/2016
Not cancer treatment, but important

Biosimilars: A biosimilar product is a biological product that is approved based on a showing that it is highly similar to an already-approved biological product, known as a reference product. The biosimilar also must show it has no clinically meaningful differences in terms of safety and effectiveness from the reference product. Only minor differences in clinically inactive components are allowable in biosimilar products.

- Filgrastim: a biosimilar to US-licensed Neupogen for the same five indications for which US-licensed Neupogen is used. The formulation of ZARXIO differs from that of US-licensed Neupogen in one active component
  - patients with cancer receiving myelosuppressive chemotherapy;
  - patients with acute myeloid leukemia receiving induction or consolidation chemotherapy;
  - patients with cancer undergoing bone marrow transplantation;
  - patients undergoing autologous peripheral blood progenitor cell collection and therapy; and
  - patients with severe chronic neutropenia.

http://www.fda.gov/Drugs/InformationOnDrugs/ApprovedDrugs/ucm279174.htm

Tips for Learning about New Cancer Therapies

- Know the type of drug
  - Small molecule, monoclonal antibody, vaccine, cytotoxic

- Know the generic name

- Know the target and what does normally in the body/what other FDA-approved drugs are similar

- Know if the drug is "personalized" to tumor's genomic profile
I know the generic name; but how do I pronounce it and how do I learn more??

http://www.cancer.gov/dictionary

http://www.mycancergenome.org/content/molecular-medicine/overview-of-targeted-therapies-for-cancer/

Reference list at end of slide set

Once potential targets are identified, then drugs are designed to best attack the target
**nibs**
(tinibs)

- Small molecules; tyrosine kinase inhibitors
- Oral
  - Adherence
  - Possible drug/food, drug/drug interactions
  - Patient education regarding taking medication correctly
- Targets vary: EGFR, VEGFR, and others
- Examples
  - erlotinib, sunitinib, ponatinib, imatinib, dasatinib, ibrutinib

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**nibs**
(rafenibs, metanib)

- Small molecules; kinase inhibitors targeting the RAF/RAS/MET pathway
- Oral
  - Adherence
  - Possible drug/food, drug/drug interactions
  - Patient education regarding taking medication correctly
- Examples
  - sorafenib, dabrafenib, trametinib, vemurafenib

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**ibs**
(lisib)

- Small molecules; PI3 kinase inhibitors (PI3K)
- Oral
  - Adherence
  - Possible drug/food, drug/drug interactions
  - Patient education regarding taking medication correctly
- Examples:
  - idelalisib
ibs (degibs)

- Small molecules; sonic hedgehog pathway inhibitors
- Oral
  - Adherence
  - Possible drug/food, drug/drug interactions
  - Patient education regarding taking medication correctly
- Examples:
  - sonidegib, vismodegib

ibs (ciclibs)

- Small molecules; inhibitor of cyclin dependent kinase (CDK) 4 & 6
- Oral
  - Adherence
  - Possible drug/food, drug/drug interactions
  - Patient education regarding taking medication correctly
- Examples:
  - palbociclib

zomibs

Small molecules; proteasome inhibitors

May be IV/subq or oral

If IV
- Only slight chance of infusion reactions; not monoclonal antibodies
If oral
- Adherence
- Possible drug/food, drug/drug interactions
- Patient education regarding taking medication correctly

Examples
- bortezomib, carfilzomib
inostat

Small molecules; HDAC inhibitors

May be IV or oral

If IV
- Only slight chance of infusion reactions; not monoclonal antibodies
If oral
- Adherence
- Possible drug/food, drug/drug interactions
- Patient education regarding taking medication correctly

Examples
- vorinostat, belinostat

What does the name mean?

Monoclonal antibody = mab

- tositumomab and iodine 131
  - mo = mouse
- rituximab
  - xi = chimeric or cross between mouse and human
- trastuzumab, bevacizumab
  - zu = humanized
- panitumumab
  - u = fully human
What does the name mean?

\[
t \text{ or } tu = \text{tumor} \\
\text{Trastuzumab}
\]

\[
ci = \text{circulatory} \\
\text{Bevacizumab}
\]

\[
l \text{ or } l = \text{immunomodulator} \\
\text{Ipilimumab}
\]

Tips for Learning about New Cancer Therapies

- Know the type of drug
  - Small molecule, monoclonal antibody, vaccine, cytotoxic
- Know the generic name
- Know the target and what is does normally in the body/what other FDA approved drugs are similar
- Know if the drug is “personalized” to tumor’s genomic profile

The New Kids on the Block

Let’s Build the Slides
ixazomib (NINLARO®)

Ixazomib (NINLARO®, Millennium Pharmaceuticals, Inc.) in combination with lenalidomide and dexamethasone for the treatment of patients with multiple myeloma who have received at least one prior therapy. Ixazomib is the first approved oral proteasome inhibitor.

- Monoclonal antibody or small molecule?
- Infusion rxns or drug/drug-drug/food interactions?
- Target?
- Personalized?
- Side effects?

Ixazomib (NINLARO®)

Ixazomib (NINLARO®, Millennium Pharmaceuticals, Inc.) in combination with lenalidomide and dexamethasone for the treatment of patients with multiple myeloma who have received at least one prior therapy. Ixazomib is the first approved oral proteasome inhibitor.

- Small molecule; oral
- Interacts with CYP3A inducers
- Target: proteasome inhibitor
- Not personalized
- Side effects: myelosuppression, GI toxicities, peripheral neuropathy, peripheral edema, cutaneous rashes, hepatotoxicity.
- Other proteasome inhibitors: bortezomib, carfilzomib

palbociclib (IBRANCE®)

Palbociclib (IBRANCE®, Pfizer) indicated in combination with letrozole for the treatment of postmenopausal women with estrogen receptor (ER)-positive, human epidermal growth factor receptor 2 (HER2)-negative advanced breast cancer as initial endocrine-based therapy for their metastatic disease. Additional approval in combination with fulvestrant for pretreated pts.

- Monoclonal antibody or small molecule?
- Infusion rxns or drug/drug-drug/food interactions?
- Target?
- Personalized?
- Side effects?
palbociclib (IBRANCE®)

- **palbociclib (IBRANCE®)** Pfizer indicated in combination with letrozole for the treatment of postmenopausal women with estrogen receptor (ER)-positive, human epidermal growth factor receptor 2 (HER2)-negative advanced breast cancer as initial endocrine-based therapy for their metastatic disease. Additional approval in combination with fulvestrant for pretreated pts
  - Small molecule kinase inhibitor
  - Drug/drug and drug/food interactions. CYP3A inducers, inhibitors and substrates, grapefruit
  - Targets cyclin dependent kinase (CDK) 4/6. Not personalized per se but is combined with letrozole or fulvestrant which are given for ER positive HER2 negative disease.
  - Side effects: Cytopenias, infections, GI events, neuropathy, fatigue, epistaxis

lenvatinib (Lenvima®)

- **lenvatinib (Lenvima™)** Eisai as treatment of patients with locally recurrent or metastatic, progressive, radioactive iodine-refractory differentiated thyroid cancer (DTC).
  - Monoclonal antibody or small molecule?
  - Infusion rxs or drug/drug, drug/food interactions?
  - Target?
  - Personalized?
  - Side effects?

lenvatinib (Lenvima®)

- **lenvatinib (Lenvima™)** Eisai as treatment of patients with locally recurrent or metastatic, progressive, radioactive iodine-refractory differentiated thyroid cancer (DTC).
  - Small molecule kinase inhibitor
  - Oral
  - Drug interactions possible (CYP3A, Pgp), but not felt to be clinically significant. No significant drug/food interactions
  - Targets VEGF receptors (anti-angiogenic), IGF receptors, PDGFRa, KIT, RET. Not personalized.
  - Side effects: Hypertension, arterial thromboembolic events, fatigue, cardiac failure, proteinuria, hepatotoxicity, GI events, palmar/plantar erythrodysthesias
alectinib (ALECENSA®)

alectinib (ALECENSA® capsules, Hoffmann-La Roche Inc.) for the treatment of patients with anaplastic lymphoma kinase (ALK)-positive metastatic non-small cell lung cancer (NSCLC) who have progressed on or are intolerant to crizotinib.

- Monoclonal antibody or small molecule?
- Infusion rxns or drug/drug - drug/food interactions?
- Target?
- Personalized?
- Side effects?

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cobimetinib (COTELLIC ™)

cobimetinib (COTELLIC ™ Tablets, Genentech, Inc.) for the treatment of patients with unresectable or metastatic melanoma with BRAF V600E or V600K mutation, in combination with vemurafenib. Cobimetinib is not indicated for treatment of patients with wild-type BRAF melanoma.

- Monoclonal antibody or small molecule?
- Infusion rxns or drug/drug - drug/food interactions?
- Target?
- Personalized?
- Side effects?
cobimetinib (COTELLIC™)

- Small molecule, oral kinase inhibitor
- Interacts with CYP3A inducers and inhibitors
- Targets MAPK, MEK1 and MEK2 kinases.
- Personalized in BRAF V600E or V600K mutations
- Side effects: new primary cutaneous and non-cutaneous malignancies, hemorrhage, cardiomyopathy, severe dermatologic rxs, retinopathy, hepatotoxicity, rhabdomyolysis, severe photosensitivity, GI symptoms, lab abnormalities, Thrombosis

osimertinib (TAGRISSO™)

- Monoclonal antibody or small molecule?
- Infusion rxs or drug/drug drug/food interactions?
- Target?
- Personalized?
- Side effects?

osimertinib (TAGRISSO™), AstraZeneca Pharmaceuticals LP, for the treatment of patients with metastatic epidermal growth factor receptor (EGFR) T790M mutation-positive non-small cell lung cancer (NSCLC), as detected by an FDA-approved test, who have progressed on or after EGFR tyrosine kinase inhibitor (TKI) therapy.

- Small molecule, oral kinase inhibitor
- Interacts with CYP3A inducers and inhibitors, and substrates of CYP3A, BCRP or CYP2C families
- Targets EGFR T790M mutations
- Personalized to tumors with EGFR T790M mutations
- Side effects: Interstitial lung disease, QTc prolongation, cardiomyopathy, diarrhea, rash, dry skin, nail toxicity
dinutuximab (Unituxin™)

dinutuximab (Unituxin™) United Therapeutics Corporation: in combination with granulocyte-macrophage colony stimulating factor (GM-CSF), interleukin-2 (IL-2), and 13 cis-retinoic acid (RA) for tx of pediatric pts with high-risk neuroblastoma who achieve at least a partial response to 1st line multiagent, multi-modality tx.

- Monoclonal antibody or small molecule?
- Infusion rxns or drug/drug/food interactions?
- Target?
- Personalized?
- Side effects?

sonidegib (Odomzo®)

- sonidegib (Odomzo) Novartis: for the treatment of patients with locally advanced basal cell carcinoma (BCC) that has recurred following surgery or radiation therapy, or those who are not candidates for surgery or radiation therapy.

- Monoclonal antibody or small molecule?
- Infusion rxns or drug/drug/food interactions?
- Target?
- Personalized?
- Side effects?
**sonidegib (Odomzo®)**

- **sonidegib (Odomzo Capsules) Novartis** for the treatment of patients with locally advanced basal cell carcinoma (BCC) that has recurred following surgery or radiation therapy, or those who are not candidates for surgery or radiation therapy.
  - Small molecule, oral
  - Drug/drug, drug/food interactions: with CYP3A inhibitors and inducers
  - Target: Hedgehog pathway
  - Personalized: No
  - Side effects: muscle spasms, musculoskeletal pain, alopecia, dysgeusia, fatigue, nausea, diarrhea, decreased weight, decreased appetite, myalgia, abdominal pain, headache, pain, vomiting, pruritus, embryo-fetal toxicity.

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**gefitinib (Iressa®)**

- **gefitinib (IRESSA®, Iressa®) AstraZeneca** for the treatment of patients with metastatic non-small cell lung cancer (NSCLC) whose tumors have epidermal growth factor receptor (EGFR) exon 19 deletions or exon 21 (L858R) substitution mutations as detected by an FDA-approved test. This approval of gefitinib is being approved concurrently with a labeling expansion of the therascreen EGFR RGQ PCR Kit companion diagnostic test for patient selection.
  - Monoclonal antibody or small molecule?
  - Infusion rxs or drug/drug, drug/food interactions?
  - Target?
  - Personalized?
  - Side effects?

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**gefitinib (Iressa®)**

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  - Small molecule: tyrosine kinase inhibitor
  - Interacts with CYP3A4 Inducers and inhibitors; proton pump inhibitors; warfarin
  - Target: EGFR (epidermal growth factor receptor)
  - Personalized to EGFR exon 19 deletions or exon 21 (L858R) substitution tumor mutations.
  - Side effects: rash/dermatologic toxicities, diarrhea, interstitial lung disease, hepatotoxicities, GI perforation, vascular toxicities.
necitumumab (PORTRAZZA™)

necitumumab (PORTRAZZA™, Eli Lilly and Company) in combination with gemcitabine and cisplatin for first-line treatment of patients with metastatic squamous non-small cell lung cancer (NSCLC). Necitumumab is not indicated for treatment of non-squamous NSCLC.

- Monoclonal antibody or small molecule?
- Infusion rxns or drug/drug drug/food interactions?
- Target?
- Personalized?
- Side effects?

www.portrazza.com

daratumumab (DARZALEX ™)

daratumumab injection (DARZALEX™, Janssen Biotech, Inc.), single agent for the treatment of patients with multiple myeloma who have received at least three prior lines of therapy, including a proteasome inhibitor (PI) and an immunomodulatory agent, or who are double-refractory to a PI and an immunomodulatory agent.

- Monoclonal antibody or small molecule?
- Infusion rxns or drug/drug drug/food interactions?
- Target?
- Personalized?
- Side effects?

www.darzalex.com
**daratumumab (DARZALEX™)**

- **daratumumab injection (DARZALEX™, Janssen Biotech, Inc.),** single agent for the treatment of patients with multiple myeloma who have received at least three prior lines of therapy, including a proteasome inhibitor (PI) and an immunomodulatory agent, or who are double-refractory to a PI and an immunomodulatory agent.
  - Monoclonal antibody; fully human IV
  - Infusion rxs are possible (46%). Premed with corticosteroids, antipyretics, and antihistamines. Post med with corticosteroids, possible with bronchodilators
  - Targets CD38
  - Not personalized
  - Side effects: Infusion rxs, interference with cross matching & red blood cell antibody screening, fatigue, nausea, back pain, cough, pyrexia, URI, hypoxemia, pneumonia

**elotuzumab (EMPLICITI™)**

- **elotuzumab (EMPLICITI™, Bristol-Myers Squibb Company) in combination with lenalidomide and dexamethasone for the treatment of patients with multiple myeloma who have received one to three prior therapies.**
  - Monoclonal antibody or small molecule?
  - Infusion rxs or drug/drug drug/food interactions?
  - Target?
  - Personalized?
  - Side effects?

- **elotuzumab (EMPLICITI™) in combination with lenalidomide and dexamethasone for the treatment of patients with multiple myeloma who have received one to three prior therapies.**
  - Monoclonal antibody; humanized
  - Infusion rxs possible (10%); premedicate with dexamethasone, diphenhydramine, ranitidine, and acetaminophen
  - Targets SLAMF-7; immunomodulatory
  - Not personalized
  - Side effects: Infusion rxs, infections, second primary malignancies, hypoglycemia, fatigue, GI toxicities, pyrexia, cough, peripheral neuropathy, pneumonitis, URI, REMS
panobinostat (FARYDAK®)

**panobinostat (FARYDAK®)** Novartis: in combination with bortezomib and dexamethasone for tx of multiple myeloma after 2 prior regimens including bortezomib and an immunomodulatory agent

- Monoclonal antibody or small molecule?
- Infusion rxns or drug/drug, drug/food interactions?
- Target?
- Personalized?
- Side effects?

www.farydak.com

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panobinostat (FARYDAK®)

**panobinostat (FARYDAK®)** Novartis: in combination with bortezomib and dexamethasone for tx of multiple myeloma after 2 prior regimens including bortezomib and an immunomodulatory agent

- Small molecule; oral
  - Drug/drug interactions with strong CYP3A4 inhibitors, inducers, and substrates. Also interacts with anti-arrhythmic and QT prolonging drugs. Drug/food interactions
  - Not personalized. Histone deacetylase inhibitor (HDAC inhibitor)

Side Effects: Thrombocytopenia, neutropenia, anemia, infection, hepatitis, hemorrhage, cardiac toxicities, nausea/vomiting, fatigue, pyrexia, diarrhea (can be severe), peripheral edema. Vorinostat is also a HDAC inhibitor.

www.farydak.com

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talimogene laherparapvec (IMLYGIC™)

talimogene laherparapvec (IMLYGIC™, Amgen, Inc.), a genetically-modified oncolytic viral therapy indicated for the local treatment of unresectable cutaneous, subcutaneous, and nodal lesions in patients with melanoma recurrent after initial surgery.

- Monoclonal antibody or small molecule or WHAT?
- Infusion rxns or drug/drug, drug/food interactions?
- Target?
- Personalized?
- Side effects?

www.imlygic.com
talimogene laherparepvec (IMLYGIC™)

- talimogene laherparepvec (IMLYGIC™, Amgen, Inc.), a genetically-modified oncolytic viral therapy indicated for the local treatment of unresectable cutaneous, subcutaneous, and nodal lesions in patients with melanoma recurrent after initial surgery.
  - Monoclonal antibody or small molecule? Neither, a genetically modified live oncolytic herpes virus (replicates inside the cancer cells and causes cell death)
  - Infusion rate or drug-drug, drug-food interactions? Acyclovir or other antiviral agents may interfere with effectiveness. Healthcare personnel must take precautions to note, handle and administer
  - Target: not molecularly targeted
  - Not personalized
  - Side effects: fatigue, chills, fever, nausea, flu-like symptoms, pain at injection site, cellulitis, immune mediated events, herpetic infections (do not give to immune suppressed pts or pregnant pts)

trifluridine & tipiracil (LONSURF™)

- trifluridine & tipiracil (LONSURF™, TAS-102, Taiho Pharma): for the treatment of pts with metastatic colorectal cancer who have been treated with fluoropyrimidine, oxaliplatin & irinotecan chemo, an anti-VEGF therapy, and, if KRAS WT, an anti-EGFR therapy
  - Monoclonal antibody or small molecule or what?
  - Infusion rate or oral with drug-drug, drug-food interactions?
  - Target?
  - Personalized?
  - Side effects?

trifluridine & tipiracil (LONSURF™)

- trifluridine & tipiracil (LONSURF™, TAS-102, Taiho Pharma): for the treatment of pts with metastatic colorectal cancer who have been treated with fluoropyrimidine, oxaliplatin & irinotecan based chemo, an anti-VEGF therapy, and, if KRAS WT, an anti-EGFR therapy
  - Monoclonal antibody or small molecule? Neither, cytotoxic agent
  - Oral, but no known drug-drug or drug-food interactions
  - Not molecularly targeted; cytotoxic. Trifluridine is an anti-neoplastic thymidine-based nucleoside and tipiracil helps maintain blood concentrations of trifluridine by inhibiting an enzyme that degrades trifluridine
  - Not personalized
  - Side effects: Severe myelosuppression, fatigue, nausea/vomiting/diabetes, abdominal pain, pruritis, decreased appetite

www.imlygic.com

www.lonsurf.com

www.lonsurf.com
trabectedin (Yondelis®)

trabectedin (Yondelis Injection, Janssen): for the treatment of patients with unresectable or metastatic liposarcoma or leiomyosarcoma who have received a prior anthracycline-containing regimen.

- Monoclonal antibody or small molecule or what?
  - Infusion 1 or oral with drug/drug, drug/food interactions?
  - Target?
  - Personalized?
  - Side effects?

www.yondelis.com

irinotecan liposome (ONIVYDE™)

- irinotecan liposome injection (ONIVYDE™, Merrimack) is indicated, in combination with fluorouracil (5-FU) and leucovorin (LV), for the treatment of patients with metastatic adenocarcinoma of the pancreas after disease progression following gemcitabine-based therapy.
- Limitation of Use: ONIVYDE is not indicated as a single agent for the treatment of patients with metastatic adenocarcinoma of the pancreas.

- Monoclonal antibody or small molecule or what?
  - Infusion 1 or oral with drug/drug, drug/food interactions?
  - Target?
  - Personalized?
  - Side effects?

www.onivyde.com
irinotecan liposome (ONIVYDE™)

- irinotecan liposome injection (ONIVYDE™, Merrimack) is indicated, in combination with fluorouracil (5-FU) and leucovorin (LV), for the treatment of patients with metastatic adenocarcinoma of the pancreas after disease progression following gemcitabine-based therapy. Limitation of Use: ONIVYDE is not indicated as a single agent for the treatment of patients with metastatic adenocarcinoma of the pancreas.

- Monoclonal antibody or small molecule or what? Cytotoxic agent

- Infusion rans or oral with drug/drug, drug/food interactions? IV and can have hypersensitivity reactions (can be severe). IV can have interactions with strong CYP3A inducers and inhibitors

- Not targeted (topoisomerase I inhibitor within a liposome): Not personalized

- Side effects? Lymphopenia, neutropenia (can be severe; febrile leading to sepsis). GI side effects (diarrhea can be severe). Fatigue, asthenia, pyrexia, stomatitis, interstitial lung disease

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Trend with New Agents is Interdisciplinary Approach

- Dermatology: Rash, other dermatologic conditions, skin cancers

- Ophthalmology: Vision issues

- Cardiology: Prolonged QTC intervals, lowering of LVEF, hypertension. Cardio-oncology is now a sub-specialty

- Gastroenterology: Development of polyps, colitis

- Endocrinology: Hypophysitis, diabetes, thyroid issues

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Future Directions
Unleashing the Immune System

Checkpoint Inhibitors

- Targets that promote T-cell proliferation; allows immune system to recognize tumor antigens
- CTLA-4: cytotoxic T-lymphocyte-associated antigen-4
- PD-1: programmed cell death protein
- PD-L1: programmed cell death protein ligand 1

References

- http://www.fda.gov/Drugs/InformationOnDrugs/ApprovedDrugs/ucm324748.htm
- http://www.myccancergenome.org