When Medications Mix with Contrast Agents: The Intersection of Pharmacy and Radiology for Patient Safety and Compliance

Presented as a Live Webinar

Tuesday, April 25, 2017
1:00 PM – 2:00 PM ET

On-demand Activity
Live webinar recorded and archived to be watched at your convenience
Available after May 25, 2017

www.ashpadvantage.com/go/contrastagents

Planned by ASHP Advantage and supported by an educational grant from Guerbet Group
Activity Overview

This educational activity will describe how hospital pharmacists can become involved in the oversight and use of contrast media in their institutions with a special emphasis on chemoembolization. Faculty will address the rationale and therapeutics of chemoembolization and provide examples of pharmacy and radiology collaboration. In addition, the role of the pharmacist in improving patient safety and the medication use process in the radiology suite will also be discussed.

Learning Objectives

At the conclusion of this knowledge-based educational activity, participants should be able to

- Describe the methods of transarterial chemoembolization (TACE).
- List five practical considerations for traditional TACE of which pharmacists should be aware.
- Outline a process for pharmacy-radiology collaboration in the medication use process and patient safety procedures.
- Discuss opportunities for pharmacists to improve patient safety during diagnostic procedures.
- Describe The Joint Commission standards relating to medication management in radiology.

Continuing Education Accreditation

The American Society of Health-System Pharmacists is accredited by the Accreditation Council for Pharmacy Education as a provider of continuing pharmacy education.

This activity provides 1.0 hour (0.1 CEU – no partial credit) of continuing pharmacy education credit.

Live Activity ACPE #: 0204-0000-17-433-L05-P

On-demand Activity ACPE #: 0204-0000-17-433-H05-P

Participants will process CPE credit online at http://elearning.ashp.org/my-activities. CPE credit will be reported directly to CPE Monitor. Per ACPE, CPE credit must be claimed no later than 60 days from the date of the live activity or completion of a home-study activity.

Webinar Information

Visit www.ashpadvantage.com/go/contrastagents to find

- Webinar registration link
- Group viewing information and technical requirements
- CPE webinar processing information
When Medications Mix with Contrast Agents: The Intersection of Pharmacy and Radiology for Patient Safety and Compliance

Faculty

Eugene R. Przespolewski, Pharm.D., BCOP
Senior Oncology Pharmacist
The Jonah Center for Oncology and Hematology
Erie County Medical Center
Buffalo, New York

Eugene R. Przespolewski, Pharm.D., BCOP, is Senior Oncology Pharmacist at Erie County Medical Center (ECMC) in Buffalo, New York. In addition, Dr. Przespolewski is a faculty member at the University at Buffalo and also serves as a preceptor to pharmacy students from D’Youville College of Pharmacy and the University at Pittsburgh School of Pharmacy. He also precepts PGY-1 pharmacy residents in hematology/oncology from the University at Buffalo School of Pharmacy.

Dr. Przespolewski joined Erie County Medical Center in 2011 and assumed responsibility for starting a hematology/oncology pharmacy practice. He also facilitated clinical pharmacy involvement in the practice through Collaborative Drug Therapy Monitoring in chemotherapy-induced nausea and vomiting, oral chemotherapy monitoring program, and others.

Dr. Przespolewski graduated from Canisius College with a Bachelor of Science in Biochemistry and a minor in Classical Studies. He received his Doctor of Pharmacy degree from the University at Buffalo School of Pharmacy and Pharmaceutical Sciences.

Dr. Przespolewski has several publications and research projects in the fields of hematology and oncology. His research interest includes optimization of supportive care in oncology patients and health systems optimization of pharmacy internship program.
Sameer Gadani, M.D.
Assistant Professor of Interventional Oncology
Department of Interventional Radiology
St. Louis University Hospital
St. Louis, Missouri

Sameer Gadani, M.D., is Assistant Professor of Interventional Radiology at Saint Louis University and provides services at Saint Louis University Hospital and St. Mary’s Hospital. He trained at the University of Minnesota Medical Center and University of Texas MD Anderson Cancer Center for Interventional Radiology and Interventional Oncology. He has been working at Saint Louis University for the last four years. Before that he served as a faculty for four years at LSU-New Orleans and University of Minnesota Medical Center.

Dr. Gadani specializes in Interventional Oncology with focus on Locoregional therapy for liver cancer. His clinical and research interests include trans-arterial chemoembolization, radioembolization and ablation of liver tumors. Additionally, he specializes in interventional procedures for kidney, lung, and MSK cancers. He has extensive experience in liver transplant-related interventions, complex portal hypertension management, UFE, varicose vein ablation, kyphoplasty/vertebroplasty and prostate artery embolization.

He has presented multiple abstracts at international conferences and authored several peer-reviewed publications related to Interventional Oncology. He is actively involved in training radiology residents, interventional radiology fellows, and medical students.
Disclosures

In accordance with the Accreditation Council for Continuing Medical Education’s Standards for Commercial Support and the Accreditation Council for Pharmacy Education’s Standards for Commercial Support, ASHP requires that all individuals involved in the development of activity content disclose their relevant financial relationships. A person has a relevant financial relationship if the individual or his or her spouse/partner has a financial relationship (e.g. employee, consultant, research grant recipient, speakers bureau, or stockholder) in any amount occurring in the last 12 months with a commercial interest whose products or services may be discussed in the educational activity content over which the individual has control. The existence of these relationships is provided for the information of participants and should not be assumed to have an adverse impact on the content.

All faculty and planners for ASHP education activities are qualified and selected by ASHP and required to disclose any relevant financial relationships with commercial interests. ASHP identifies and resolves conflicts of interest prior to an individual’s participation in development of content for an educational activity. Anyone who refuses to disclose relevant financial relationships must be disqualified from any involvement with a continuing pharmacy education activity.

- All faculty and planners report no financial relationships relevant to this activity.
Learning Objectives

At the conclusion of this educational activity, participants should be able to

- Describe the methods of transarterial chemoembolization (TACE).
- List five practical considerations for traditional TACE of which pharmacists should be aware.
- Outline a process for pharmacy-radiology collaboration in the medication use process and patient safety procedures.
- Discuss opportunities for pharmacists to improve patient safety during diagnostic procedures.
- Describe the Joint Commission standards relating to medication management in radiology.

Transarterial chemoembolization: what a pharmacist need to know

Sameer Gadani, MD
Assistant Professor
Division of Interventional Radiology
Saint Louis University Hospital
St. Louis, Missouri

Which type of transarterial chemoembolization is performed more frequently at your institute?

a. Conventional TACE
b. Drug-eluting beads TACE
c. Both

What are the indications of transarterial chemoembolization?

a. Hepatocellular carcinoma (HCC)
b. Colorectal metastasis to liver
c. Neuroendocrine metastasis to liver
d. All of the above
Transarterial chemoembolization is:

a. Curative treatment  
b. Palliative treatment  
c. Both

Conventional TACE involves hepatic artery injection of:

a. Chemotherapeutic agents  
b. Chemotherapeutic agents + ethiodized oil (Lipiodol®)  
c. Chemotherapeutic agents + ethiodized oil followed by embolization

Which of the following chemotherapeutic agent cannot be ‘loaded’ on the beads?

a. Doxorubicin  
b. Irinotecan  
c. Mitomycin C  
d. Cisplatin

Indications

- Hepatocellular carcinoma
- Metastatic colorectal tumor
- Neuroendocrine tumor metastasis to liver
- Cholangiocarcinoma
- Breast cancer / sarcoma

Hepatocellular Carcinoma

- Hepatocellular carcinoma (HCC) is a primary liver tumor and commonly seen in patients with cirrhosis secondary to variety of causes including Hepatitis C, Hepatitis B, alcohol and non-alcoholic fatty liver.
- Most common liver malignancy and one of the leading cause of cancer related deaths worldwide.
- Surveillance of high risk population helps in identification of HCC at an early stage where potentially curative therapies like surgical resection or liver transplant can be offered with 5 year survival up to 75%.

Hepatocellular Carcinoma (cont.)

- However, more than 50% of patients with HCC are diagnosed at a stage when curative therapies can not be offered.
- In these patients palliative therapies like transarterial chemoembolization or transarterial radioembolization are offered.

Mauer et al. Curr Gastroenterol Rep 2015; May 17 (5) 442. Copyright © 2017, American Society of Health-System Pharmacists, Inc. All rights reserved.
Hepatocellular Carcinoma (cont.)

- Therapies offered to the patient with advanced HCC depends on number and size of tumor(s), liver function, performance status, vascular invasion and presence of extrahepatic disease.
- Barcelona clinic liver cancer (BCLC) classification is most accepted system for stratification and recommendation of treatment for HCC.

Colorectal Cancer Metastasis

- Colorectal cancer is third most common cancer worldwide
- Synchronous metastasis in the liver is present in 15-20% patients and metachronous in more than 50% patients
- Liver is most common site of metastasis. It is only site of metastasis in 40% patients.
- Surgical resection of the primary site, resection of the liver metastasis (possible in only 20% patients) and chemotherapy is standard of care.

Colorectal Cancer Metastasis (cont.)

- For the patients with surgically unresectable metastasis:
  – 5 FU and leucovorin (median survival 12 mths)
  – Irinotecan and oxaliplatin (median survival 20 mths)
  – Bevacizumab or cetuximab (additional benefit)
- TACE is offered in patients with nonresectable liver metastasis. It is offered concomitant with chemotherapy or in patients with poor response or refractory to chemotherapy.

Neuroendocrine Tumors

- Neuroendocrine tumors originate from foregut, midgut or hindgut.
- Presence of liver metastasis negatively impacts prognosis.
- Treatment options include surgical resection, TAE, TACE or radioembolization.

Rationale for TACE

- Liver has dual blood supply via hepatic artery and portal vein.
- 70% of blood supply to the liver is through the portal vein and 30% is from hepatic artery
- Dominant blood supply to the liver tumor is through the hepatic artery (80%) and portal vein branches (20%).
- Intra-arterial injection of the chemotherapeutic agents along with embolic material ensures their high concentration in the tumor with minimal effect on the normal liver.
### Types of TACE

- Conventional TACE (cTACE)
- Drug-eluting beads TACE (DEBTACE)

### Conventional TACE

**Components:**
- Chemotherapeutic agents (Doxorubicin, mitomycin C)
- Ethiodized oil
- Embolic material
  - Sterile compressed sponge (Gelfoam®)
  - PVA embolization particles (Contour™)
  - TAG microspheres (MagPlex®)

**Rationale:**
- Single drug therapy – doxorubicin
- Combination drug therapy – doxorubicin, mitomycin C
- Embolization combined with the delivery of drugs with high hepatic extraction ratios and steep dose-response curve can maximize the advantage of local delivery.
- Complete embolization results in zero extraction of these agents by the liver.
- Pharmacokinetics of these chemotherapeutic agents are altered when combined with ethiodized oil.

### Conventional TACE (cont.)

- Higher density – keeps the emulsion stable.
- Higher than blood viscosity – embolic effect.
- It is distributed through the hepatic arterioles in the peribiliary plexus reaching up to its portal venules (dual embolic effect).


Conventional TACE (cont.)

- Formation of emulsion, basic pharmacokinetics and mechanism of action:
  - Single agent: 50 mg doxorubicin diluted in water soluble contrast for 10 mL volume.
  - Combination: Cisplatin 100 mg, doxorubicin 50 mg and mitomycin C 10 mg diluted in water soluble contrast for 10 mL volume. Consult your protocol for specific admixture direction.
  - Polycarbonate or glass syringes / three way stopcocks.

- 1.0 mL aqueous solution (chemo) and 15-20 mL ethiodized oil.
- Vigorous mixing (30-40 times) to prepare WATER IN OIL emulsion
- Release of doxorubicin from the lipiodol depends on:
  - Ratio of aqueous and lipid phase
  - Stability of emulsion
  - Type of mixing procedure (vigorous mixing – with goal of inner and outer droplet size of 20 and 100 microns respectively)


Conventional TACE (cont.)

- Doxorubicin use in HCC is an off-label use. Once released, doxorubicin damages the DNA of the tumor cell by:
  - Binding to topoisomerase II
  - Intercalation to DNA base pair
  - Free radical formation


Conventional TACE (cont.)

- Beads:
  - DC beads – doxorubicin or irinotecan
  - LC beads LUMI™
  - SAP-MS (Superabsorbent polymer microspheres) – QuadraSpheres®
  - Precision beads – preloaded with doxorubicin (37.5 mg/mL)
  - Paragon beads – preloaded with irinotecan


Transarterial chemoembolization with drug-eluting beads (DEB-TACE)

- Rationale:
  - Beads can be eluted with chemotherapeutic agents
  - They can carry the chemo agents up to the tumor and release them over the period of hours
  - Beads also has embolic effect leading to tumor hypoxia and infarction
  - Ratio of concentration of chemotherapy agents in the tumor: plasma markedly high
  - Improved pharmacokinetics over conventional TACE
  - Relatively less pain

How to load, mechanism of action and pharmacokinetics

- DC Beads:
  - Approved for Hypervascular tumor. Off label use for drug sequestration and TACE.
  - DC beads sequester oppositely charged drugs through ion exchange mechanism.
  - Maximum loading – 45 mg/mL (doxorubicin) and 50-60 mg/mL (irinotecan)
  - Ideal loading – 37.5 mg/mL (doxorubicin).
  - Drug sequestration depends on bead size, concentration of drug and salt-loading solution concentration.

- Bead size decreases after sequestration. Larger beads decrease in size more as compared to the smaller beads.
- SAP-MS – biocompatible, hydrophilic and nonresorbable
  - SAP-MS increase in size four times after sequestration.
  - They can absorb fluid 64 times their dry volume.
  - Doxorubicin or cisplatin can be loaded.
  - FDA approved for TACE.

How to load, mechanism of action and pharmacokinetics

- Drug eluting beads are injected in the arteries reaching up to the tumor.
- Beads cause embolization of the arteries and also slowly release doxorubicin in exchange for cations.
- Release of doxorubicin from the beads depends on the bead size and concentration of doxorubicin. Released up to 30 days.
- Highest concentration of doxorubicin in the tissue noted adjacent to the beads. Quantifiable plasma concentration seen up to 7 days.

Pre-procedure Assessment

- Clinic visit
- Confirming eligibility for TACE
- LABS:
  - CBC
  - CMP
  - Coagulation studies (e.g. aPTT, PT, d-dimer, fibrinogen)
  - AFP
  - MELD, Child-pugh Score
  - Liver function tests
- ECOG performance status.
- MRI / CT scan of the liver (three phase)

ECOG: Eastern Cooperative Oncology Group

Pre-procedure Assessment

- Day of the procedure:
  - Cefazolin: 1 gm i.v. (optional)
  - Dexamethasone: 10 mg i.v.
  - Ondansetron: 8 mg i.v.
  - Diphenhydramine: 50 mg i.v.
  - i.v. NS 75 mL/hr for 6-8 hrs (pre-intra-post procedure).
- Post procedure
  - Narcotics (prn).
- Clinic visit in 6 weeks with imaging
Key Takeaways

- Key take away # 1 : TACE is offered as palliative treatment for primary hepatocellular carcinomas and few other primary tumors metastasized to the liver
- Key take away # 2 : Ethiodized oil (Lipiodol®) is an excellent carrier of chemotherapy agents and is key ingredient of conventional TACE. 'Water in oil' is ideal emulsion for intra-arterial injection.
- Key take away # 3 : Different size and types of drug-eluting beads are available, which can carry doxorubicin, irinotecan or cisplatin.

Contrast agents are considered medications according to the Joint Commission?

a. True
b. False
TACE in a Nutshell

- TACE is a form of liver directed or local therapy (as opposed to systemic)
- Ethiodized oil (Lipiodol®) and drug-eluting beads ("DEBs") serve multiple purposes:
  - Delivery of directed cytotoxicity
  - Control and prolong effect in tumor microenvironment
  - Act as or contain contrast
- The goal is to maximize kill and minimize toxicity
- Harmony of radiology and pharmacy

TACE = Transarterial chemoembolization therapy

The Marriage of Radiology and Pharmacy

- The Joint Commission: contrast media is a medication
- Contrast media is subjected to same scrutiny as other medications:
  - Storage requirements
  - Reviewing of orders
  - Medication labeling
  - Medication dispensing
- Should be recorded in electronic medical record (EMR) and orderable via computerized physician order entry (CPOE)

The Machinery in Motion

Case of Contrast Contamination

- Patients in Arizona pain clinic injected with diluted contrast to guide epidural injections
  - Contrast agent was a single dose
- Personnel diluted contrast and placed in a separate vial to be used as a multidose vial (MDV)
  - "MDV" contaminated with methicillin-resistant staphylococcus aureus (MRSA)
- 3 patients developed severe infections

ISMP Recommendations

- Confusion over pharmacy bulk pack (PBP) container vs. MDV:
  - PBP contain multiple single doses
  - PBP do NOT contain preservatives
  - Special handling requirements labeled on packaging
- PBP of contrast media to be drawn up in laminar flow hood
- Pharmacy department should develop rapport with radiology department


Which of the following chemotherapeutic agents have been used in TACE procedures?

a. DOXOrubicin
b. Irinotecan
c. MitoMYcin
d. All of the above

Copyright © 2017, American Society of Health-System Pharmacists, Inc. All rights reserved.
Institutions may already have established procedures.

Common chemotherapy used:
- DOXOrubicin
- MitoMYcin
- CI5platin
- Irinotecan

CTACE and DEB-TACE have distinct compounding processes:
- DEB manufacturers have different load times.
- Choice in bead size must be specified.


DOXOrubicin in TACE
- MOA: Anthracycline antibiotic
  - Major: DNA-intercalation stabilizing Topoisomerase II
- Dose: No standard dosing
  - Flat dosing: 50 – 150 mg
  - BSA dosing: 50 – 75 mg/m²
- PK/PD: based on TACE procedure
  - Ethodized oil (Lipiodol®): Technique dependent, variable Cmax, larger AUC
  - DEB: Bead size dependent, consistent release

Tam. ADMET & DMPK. 2013 (31) 29-44.

Conventional TACE Compounding
- Chemotherapy + ethodized oil + embolizing agents
- Drugs mixed with ethodized oil to form an emulsion
  - Water-in-oil emulsion is preferred
- Volume of drug must be minimized
  - Preference for DOXOrubicin powder drug source
- Drug mixed with ethodized oil in interventional radiology (IR) suite
  - Drug pushed into ethodized oil


Drug-Eluting Beads Compounding
- Product specific compounding processes:
  - LC Beads®
  - QuadraSphere® (HepaSphere in Europe)
- Not FDA approved for use in USA
- Can use DOXOrubicin solution products
- Beads need to be "loaded," with drug prior to use
  - Requires time to dwell
  - More complex compounding procedure


According to USP Chapter 800, which of the following is considered a risk of exposure to an HD?

a. Loading the DEB-TACE with doxorubicin  
b. Delivering the DEB-TACE to the IR suite  
c. Administering DEB-TACE to the patient in the IR suite  
d. Two of the above  
e. All of the above

USP <800>: Hazardous Drugs 2016.

TACE and USP <800>
- USP <800>: practice and quality standards for handling hazardous drugs (HD)
  - Protects healthcare worker, patient and everyone between
- USP <800> builds on USP <795> and <797>
- No exposure to HDs are acceptable
  - Protect yourself and others
- TACE brings HDs to non-traditional areas

USP <800> 2016.
**Breadth of USP <800>**

1. Receiving from outside
2. Compounding, Preparation & Delivery
3. Delivery

**Compounding TACE and USP <800>**

- **Know your institutions HD List**
  - May be less/more stringent than NIOSH list
- **Compounding TACE should be done in a biological safety cabinet (BSC) inside a negative pressure room**
- **Consider some DEBs require time to load**
  - USP <797> compliance: BUD requirements
  - May not be feasible in some infusion clinics
- **All agents manipulated in BSC are considered HD due to environmental exposure**

**CSTD and Administration of Drugs**

- **NIOSH first to endorse/define the idea in 2004**
- **CSTD Examples:**
  - BD PhaSeal®
  - BBraun OnGuard®
- **Compounding:** CSTD *should* be used
- **Administration:** CSTD *must* be used
  - Caveat: when dosage form allows
- **Discussion as to best approach this with TACE**

**USP <800> Educational Expectations**

- **Establishment of SOP, reviewed annually**
- **Annual HD handling competencies specific to job function:**
  - Overview of the entity’s list of HD and their risks
  - Review the entity’s SOPs related to handling HD
  - Proper use of personal protective equipment (PPE)
  - Proper use of equipment and devices (CSTD)
  - Response to known/suspected HD exposure
  - Spill management
  - Proper disposal of HDs and trace-contaminated materials

**Other USP <800> Considerations**

- **Transport issues:**
  - Minimize risk of breakage and leakage
  - Do NOT use the pneumatic tube
- **Users must have appropriate PPE**
- **Must be labeled as clearly a HD**
- **Stored in a spill-proof area**
- **Must have a spill kit readily available**
- **Must know how to dispose hazardous waste**
  - Anything exposed to drugs considered HD

**Summary of Compounding Pearls**

- **Collaboration/communication with radiology department**
- **Understanding USP <800> practical concerns**
- **Trained in procedures for institutional preferences:**
  - DEB-TACE vs. cTACE
  - Protocol?
  - How much advance notice
    - Appropriate lead time to order products
Do you have a pharmacy protocol in place to promptly manage a TACE order?

a. Yes  
b. No  
c. Maybe  
d. I don’t know

Data for Therapy
- Hepatocellular carcinoma:
  - Unresectable
  - Adjunct therapy to liver resection
  - Bridge to liver transplant
  - Combination with radiofrequency ablations
- Unresectable cholangiocarcinoma
- Neuroendocrine tumor metastased to the liver
- Metastases to the liver with the following primary malignancies:
  - Breast
  - Sarcoma
  - Colorectal


Pre-operative Considerations
- Patients will be fasting for at least 4 – 6 hours
- Hydration
- Antiemetics: Consider DOXOrubicin
  - NCCN moderate emetogenicity:
    - Dexamethasone 20 mg on day 1, 8 mg days 2 & 3
    - Granisetron 3 mg on day 1
- Antibiotics: controversial
  - May not be necessary
  - Higher risk: biliary tract disease/reconstruction
- Analgesics


Which of the following is NOT a symptom of postembolization syndrome?

a. Nausea and Vomiting  
b. Liver abscesses  
c. Abdominal pain  
d. Fever

Post-operative Complications
- Majority of patients receive 1 – 2 doses
- Most common complication:
  - Transient transaminitis
  - Postembolization syndrome
- Major post-operative complications are rare:
  - Liver infarction
  - Cholecystitis
  - Intrahepatic abscesses
  - Pancreatitis


Postembolization Syndrome (PES)
- Sequela of cytotoxicity and inflammation:
  - Nausea
  - Vomiting
  - Abdominal pain
  - Fever
- DEB-TACE may have lower rate
- May be associated with worsened prolonged survival

PES Management

- Transaminitis: self-limiting ~ 7 days
- Analgesia:
  - Intra-articular lidocaine with procedure: cTACE
  - Opiates: Pre- and post-
- Antiemetics:
  - 5-HT3 Antagonists: scheduled
  - Dexamethasone
- Antibiotics: Not warranted
  - Fever is not infection


Key Takeaways

- Key Takeaway #1
  - Develop a working relationship with Radiology Department to facilitate patients undergoing TACE
- Key Takeaway #2
  - Compounding procedures are institution-specific and USP <800> poses unique barriers to overcome
- Key Takeaway #3
  - There are unique pre- and post-operative issues in patients undergoing TACE

Which of these practice changes will you consider making? (Select all that apply.)

- a. Foster/build relationship with radiologists to better care for TACE patients
- b. Evaluate current TACE protocol/develop one
- c. Review/change chemotherapy prep procedure
- d. Optimize protective measures of USP 800 in TACE preparation
- e. Utilize complication management strategies to decrease LOS and increase patient satisfaction

Selected Resources

- USP <800> Hazardous Drugs- Handling in Healthcare Settings.
When Medications Mix with Contrast Agents: The Intersection of Pharmacy and Radiology for Patient Safety and Compliance

Self-assessment Questions

The polling questions included in this presentation are listed below as a learner assessment tool. You may wish to note the correct answers and rationale as you follow along with the speaker.

1. Which type of transarterial chemoembolization is performed more frequently at your institute?
   a. Conventional TACE.
   b. Drug-eluting beads TACE.
   c. Both.

2. What are the indications of transarterial chemoembolization?
   a. Hepatocellular carcinoma (HCC).
   b. Colorectal metastasis to liver.
   c. Neuroendocrine metastasis to liver.
   d. All of the above.

3. Transarterial chemoembolization is:
   c. Both.

4. Conventional TACE involves hepatic artery injection of:
   a. Chemotherapeutic agents.
   b. Chemotherapeutic agents + ethiodized oil (Lipiodol®).
   c. Chemotherapeutic agents + ethiodized oil followed by embolization.

5. Which of the following chemotherapeutic agent cannot be ‘loaded’ on the beads?
   a. Doxorubicin.
   b. Irinotican.
   c. Mitomicin C.
   d. Cisplatin.

6. Contrast media is considered a medication according to the Joint Commission?
   a. True.
   b. False.

7. Which of the following chemotherapeutic agents have been used in TACE procedures?
   a. DOXOrubicin.
   b. CISplatin.
   c. MitoMYcin.
   d. All of the above.
8. According to USP Chapter <800>, which of the following is considered a risk of exposure to an HD?
   a. Loading the DEB-TACE with doxorubicin.
   b. Delivering the DEB-TACE to the IR suite.
   c. Administering DEB-TACE to the patient in the IR suite.
   d. Two of the above.
   e. All of the above.

9. Do you have a pharmacy protocol in place to promptly manage a TACE order?
   a. Yes
   b. No
   c. Maybe
   d. I don’t know

10. Which of the following is NOT a symptom of postembolization syndrome?
    a. Nausea and Vomiting
    b. Liver abscesses
    c. Abdominal pain
    d. Fever