Split-Bolus Techniques
Beyond CT Urography

Vassilios Raptopoulos, MD
Radiation Reduction Strategies

1. Equipment
   e.g. Scanner – Reconstruction (ASIR)

2. Techniques
   e.g. Pitch – Slice thickness – mA – kVp,

3. Protocols
   e.g. Tailor to indication – IV contrast Phases

4. Utilization
   e.g. Alternative tests – Display # Exams
Split Bolus Techniques

Can provide combined phase scans including excretory-parenchymal arterial – portal venous vascular - parenchymal
CT Urography

Synchronous nephrographic and excretory phase

- Chow, LC et al: AJR (Stanford) 2007;189:314

Chow L C et al. AJR 2007;189:314-322

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CT Urography

1st bolus: Excretory
2nd bolus: Nephrographic

40 cc @ 2cc/sec for 20 sec
80 cc @ 2cc/sec for 40 sec

Synchronous excretory & nephrographic phase

- Chow, LC et al: AJR (Stanford) 2007;189:314
CT Urography - 2

1st bolus: Excretory
2nd bolus: Early nephrographic & Parenchymal/Vascular

- 40 cc @ 2/3
- 50 cc @ 3.5/s for 14 sec
- 80 cc @ 2/s
- 80 cc @ 3.5/s for 23 sec
- 70s
- 120s
- 47s
- 80s
- 4 min
- 3 min
Split bolus CT Urography

1\textsuperscript{st} bolus: Excretory

2\textsuperscript{nd} bolus: Early nephrographic & Parenchymal/Vascular
General Spit-bolus

1\textsuperscript{st} bolus: Excretory
2\textsuperscript{nd} bolus: Parenchymal & Vascular
General Spit-bolus

1\textsuperscript{st} bolus: Excretory
2\textsuperscript{nd} bolus: Parenchymal & Vascular

30 cc @ 2.5/s for 12 sec
100 cc @ 2.5/s for 40 sec

Trigger scan at
Liver enhancement of 50 HU or 70s
General Spit-bolus

- Gen Abd.
- Abd Pain
- Abscess
- Trauma
- Tumor (non-liver)
- Lymphoma
General Spit-bolus

- Gen Abd.
- Abd Pain
- Abscess
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- Tumor (non-liver)
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General Spit-bolus

- Gen Abd.
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- Tumor (non-liver)
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General Spit-bolus

- Gen Abd.
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General Spit-bolus

- Gen Abd.
- Abd Pain
- Abscess
- Trauma
- Tumor (non-liver)
- Lymphoma
Renal Split-bolus

1\textsuperscript{st} bolus: Excretory

2\textsuperscript{nd} bolus: Parenchymal & Late Arterial & Venous

- 30 cc @ 5/s for 6 sec
- 120 cc @ 5/s for 24 sec
- Ao 175HU + 15s
Renal Split-bolus

Renal donors – Renal CTA – Renal tumors

Vascular-excretory MDCT Angiography for renal donors
Split-bolus Vascular CTA

Mesenteric CTA
1\textsuperscript{st} bolus: Venous & Parenchyma
2\textsuperscript{nd} bolus: Arterial

- 70 cc @ 5/s for 14 sec
- 50 cc @ 5/s for 10 sec
- 30s
- \sim 16s
- \sim 70s

Ao 280HU
Split-bolus Vascular CTA

Aorta CTA

1\textsuperscript{st} bolus: Venous & Late Arterial

2\textsuperscript{nd} bolus: Arterial

- 50 cc @ 5/s for 10 sec
- 50 cc @ 5/s for 10 sec

~55s

Ao 280HU

Type B EVS Endoleak
Aortic Dissection

1\textsuperscript{st} bolus: Venous & Late Arterial

2\textsuperscript{nd} bolus: Arterial

Single bolus
Split-bolus Pancreas

1st bolus: Portal venous (liver)
2nd bolus: Late arterial (pancreatic)

- 100 cc @ 5/s for 20 sec
- 50 cc @ 5/s for 10 sec

Ao 280HU + 15s
Split-bolus Pancreas

1st bolus: Portal venous (liver)
2nd bolus: Late arterial (pancreatic)
Conclusions

- Split-bolus techniques allow for combine phase scanning that
- Provides vascular and parenchymal information or arterial and venous information in a single acquisition that may
- Limit multiphase scanning or
- Provide information otherwise not obtained.
- Powerful tool in radiation reduction strategies
Applications

- CT Urography
- General Scanning – Acute/chronic pain
- Trauma
- Lymphoma & other non-liver-affecting tumors
- Renal CT Angiography
- Mesenteric CTA
- Post EVS AAA follow-up
- Aortic dissection
- Pancreatic cancer