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Value of injection site monitoring using a smartphone during dynamic contrast-enhanced CT.

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Introduction

- **Contrast media extravasation** is a complication of contrast-enhanced CT, reported to occur in 0.2% of examinations. It can be particularly problematic when performing dynamic contrast-enhanced CT (DCE-CT) because injection rates are generally high and visual assessment of the injection site is not possible due to bolus tracking scans that begin shortly after the start of contrast injection.
- Although pressure monitoring is the main method to detect extravasation, it may not be reliable. Therefore, **we have developed an injection site monitoring method using a smartphone**, and evaluated its value for injection site safety during DCE-CT.

Roditi G, et al. Eur Radiol 2022;32(5):3056-3066.

Materials and Methods

Study population

- 26 radiology department members

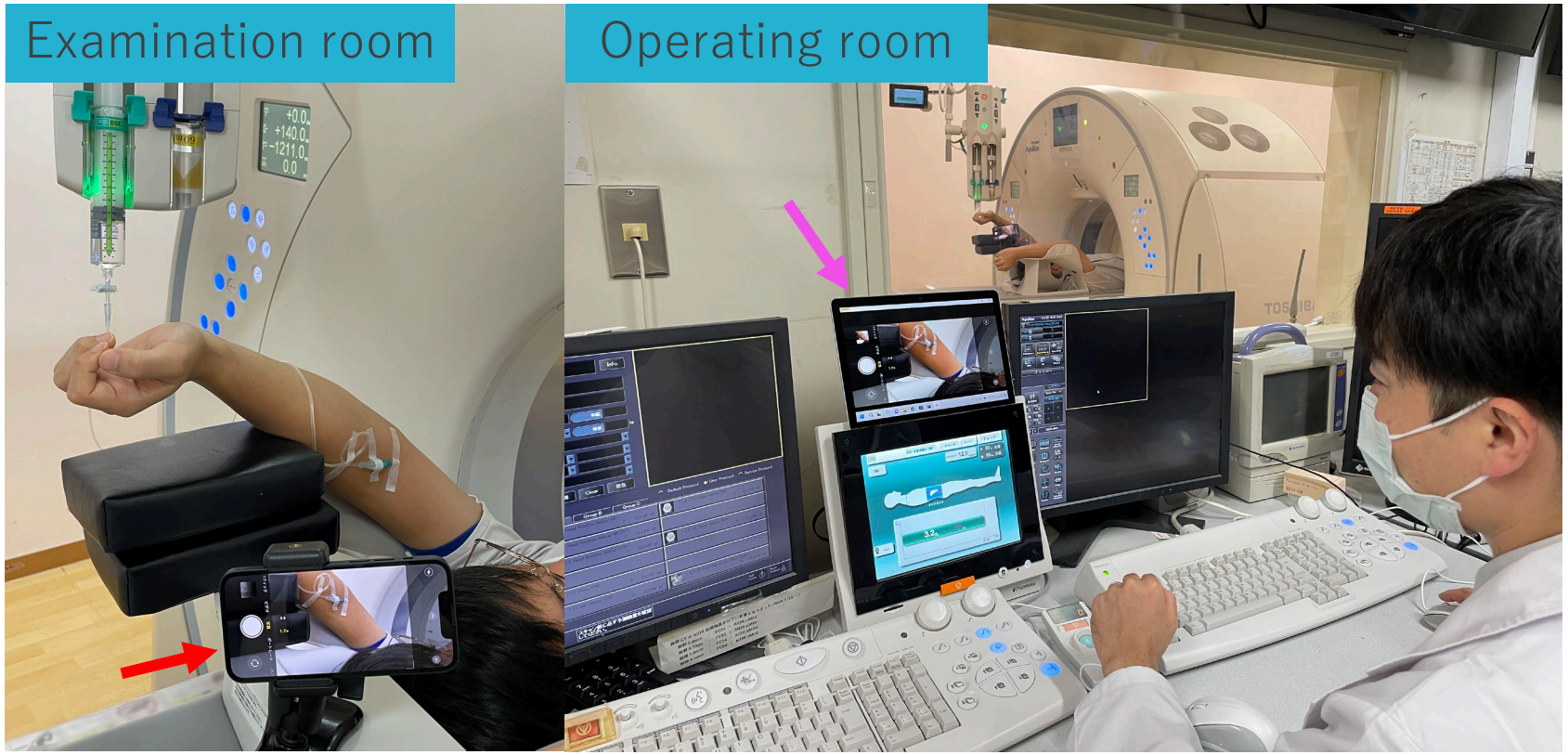
  Radiologist: n=14

  CT technologist: n=12

Surveys in DCE-CT

- 156 DCE-CT from February to March 2024
- Each participant performed 6 DCE-CT
  - 3 with pressure monitoring only during contrast injection
  - 3 with pressure and injection site monitoring
- The participants answered a questionnaire for each DCE-CT.

Injection site monitoring system



iPhone 13 mini (Apple)

Wi-Fi

Surface Go3 (Microsoft)

- Injection site monitoring was performed using a smartphone.
- The smartphone was attached to the overhead arm support on the CT bed to monitor the injection site in the patients' antecubital area, and the monitoring video was output to a tablet device in the operating room.

Questionnaire

- **Confidence in the safety of contrast injection**
  - 1 : Very anxious
  - 2 : Slightly anxious
  - 3 : Less anxious, but less confident in immediate detection of extravasation
  - 4 : Little anxious, and moderately confident in immediate detection of extravasation
  - 5 : Not anxious, and very confident in immediate detection of extravasation
- **Visibility of the injection site when using the injection site monitoring system**
  - 1 : Not visible
  - 2 : Poor
  - 3 : Fair
  - 4 : Good
  - 5 : Excellent

Statistics

- Injection rate, volume, and needle were compared between 78 DCE-CT with and without the injection site monitoring system.
  - **The Mann-Whitney test**
  - **The Chi-Square test**
- 78 DCE-CT with the pressure monitoring only
  vs.
  78 DCE-CT with the pressure and injection site monitoring system.
  - **The Mann-Whitney test**
- Mean scores of 3 DCE-CT with the pressure monitoring only in the 26 participants
  vs.
  Mean scores of 3 DCE-CT with the pressure and injection site monitoring system in the 26 participants
  - **The Wilcoxon test**

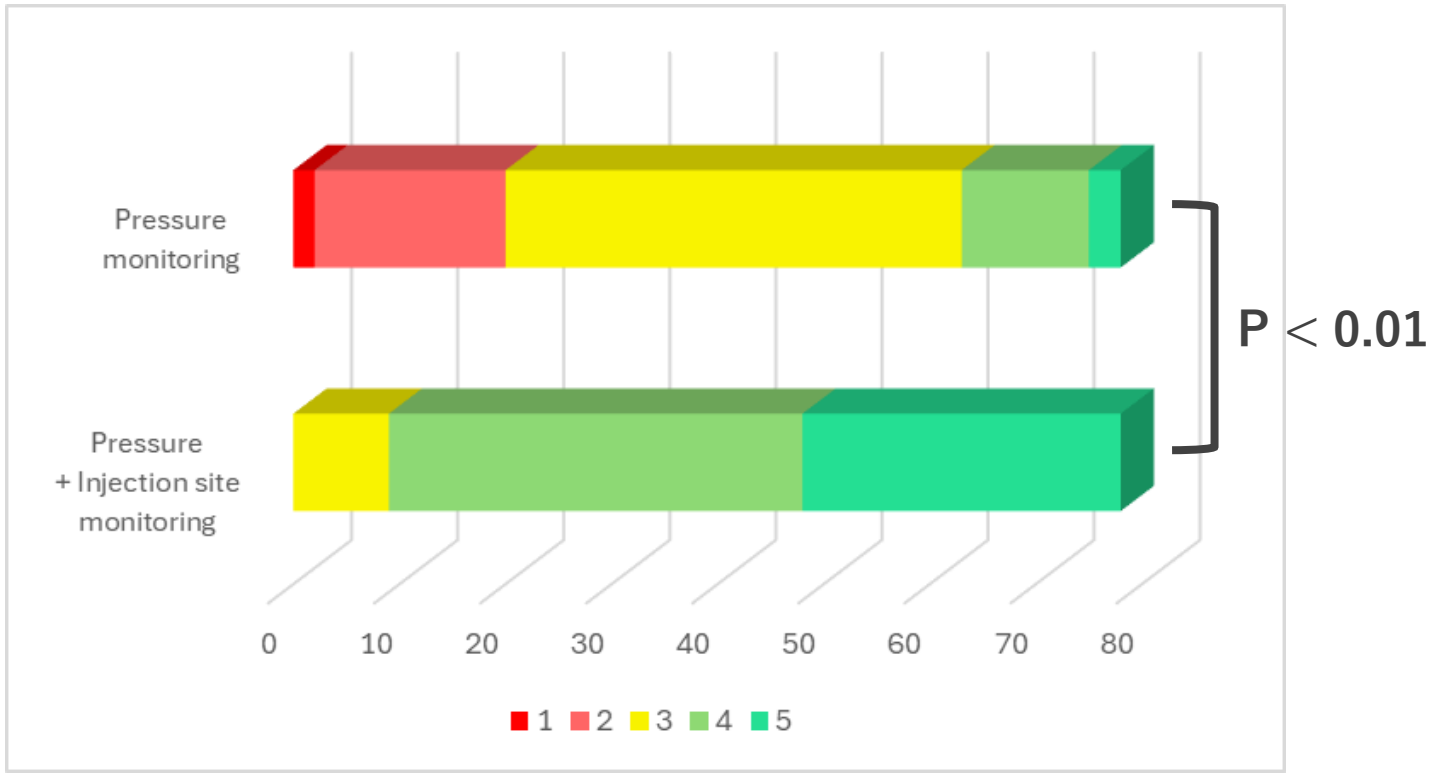
Results: characteristics of the participants and DCE-CT

- Experience of the participants in CT examination
  - Radiologists: 1-21 years, median 4 years
  - Technologists:1-15 years, median 6.5 years
- There were no significant differences in injection rate, volume, and needle between DCE-CT examinations with and without injection site monitoring.

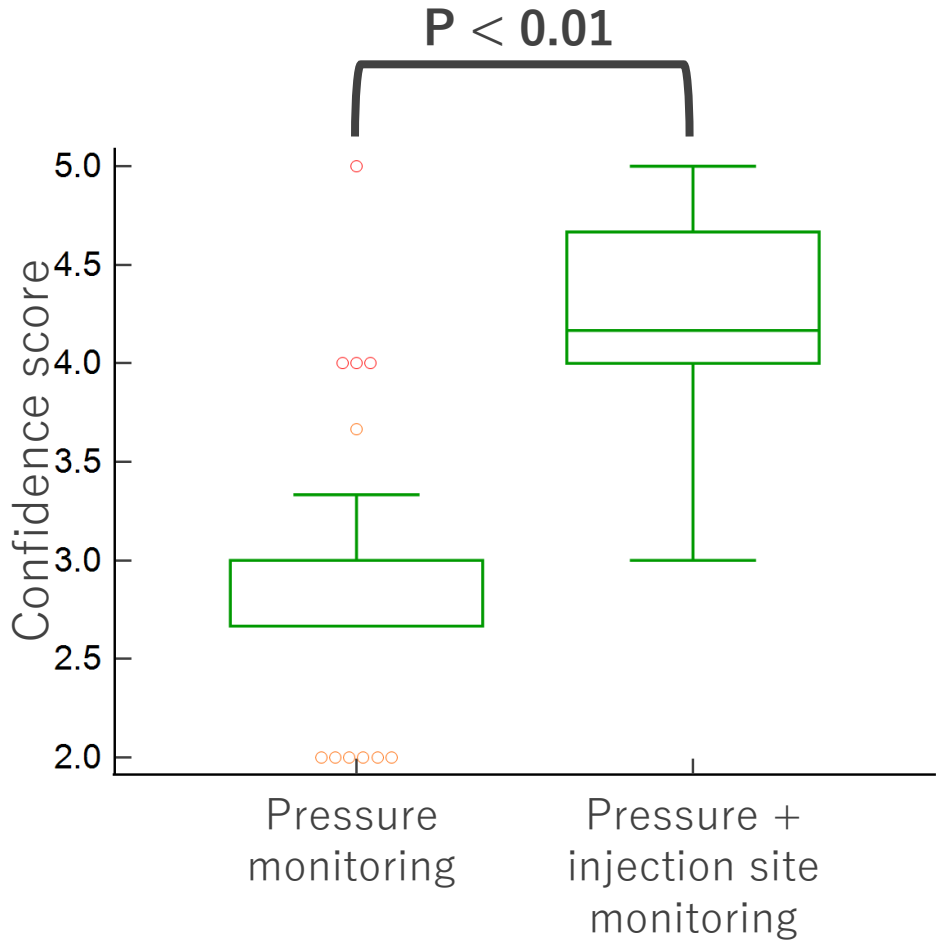
		DCE-CT without injection site monitoring	DCE-CT with injection site monitoring	P
Injection rate (ml/sec)		median, 3.2 (range, 2.0-4.5)	median, 3.2 (range, 2.5-4.1)	0.16
Injection volume (ml)		median, 96 (range, 66-143)	median, 96 (range, 76-144)	0.16
Injection needle	22G	2	3	0.65
	20G	76	75	

Results: confidence in the safety of contrast injection

Confidence scores were significantly higher in examinations with injection site monitoring than those without the system.



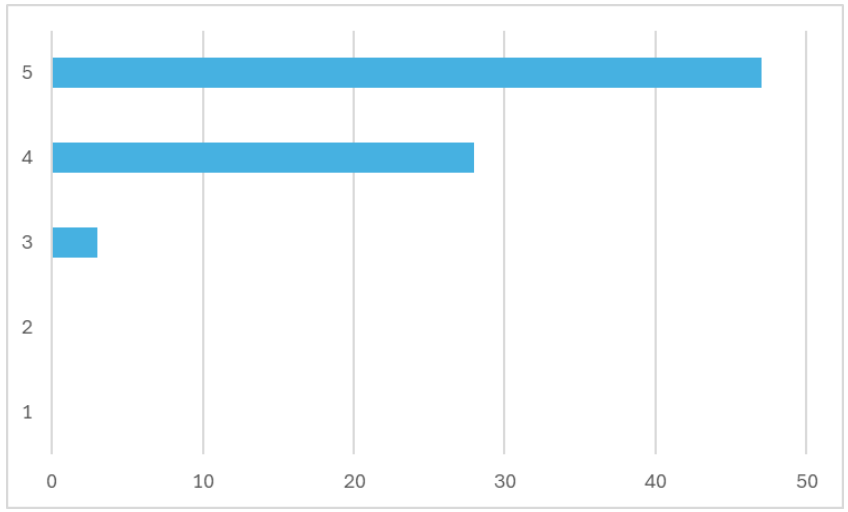
For the per-staff analysis, the confidence scores were significantly increased by the addition of injection site monitoring to the pressure monitoring.



Results: visibility of the injection site

Visibility of the injection site

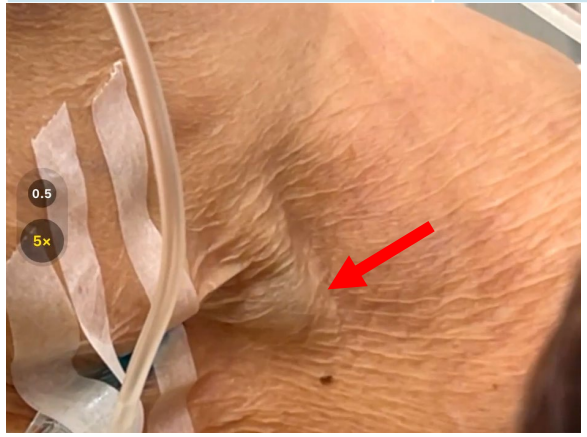
Visibility of the injection site was good or excellent in 75/78 (96.2%) examinations using the injection site monitoring system.



Visibility score

Incidence of extravasation

	DCE-CT without injection site monitoring	DCE-CT with injection site monitoring
Incidence	2	2
Detection of the extravasion	After the CT examinations	Immediately after the occurrence by the injection site monitoring system.
Extravasated volume	20 and 30 ml	Less than 5 ml in both events



Detection of extravasation using the injection site monitoring system.

Discussion and Conclusion

- The limitations of this study include the small sample size of extravasation cases and the lack of generalizability due to the single-center study design.
- Despite these limitations, the method is simple, widely available, and has the potential for future integration of artificial intelligence in automated detection of extravasation.

Thank you for your attention!