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PERSPECTVE

Entering the Era of Non-fasting Intravenous Contrast-Enhanced Computed Tomography

YS Chan[1], CCM Cho[1], CSL Tong[1], AWH Ng[2]

[1]Department of Imaging and Interventional Radiology, Prince of Wales Hospital, Hong Kong SAR, China
[2]AmMed Medical Diagnostic Center, Hong Kong SAR, China

ABSTRACT

An empirical fasting period of at least 4 hours prior to intravenous contrast administration for computed tomography scans has been an age-old practice. This is associated with patient discomfort, adverse effects on diabetic control, and limits the flexibility of scanning arrangements in urgent settings. The effect is further compounded by the rising number of urgent imaging requests with some patients requiring repeated fasting while waiting for scanning slots. International guidelines have been recently updated, stating that with the improved safety profile of contrast media, fasting is no longer routinely required. In this article, we discuss the current evidence and its implications for our local practice. We share our approach of a stepwise policy change with eventual full implementation of non-fasting policy to all eligible patients in our institution, and the safety data we compiled. Adoption of a non-fasting policy for contrast-enhanced computed tomography is a feasible and beneficial practice adhering to international standards.

Key Words: *Contrast media; Nausea; Pneumonia, aspiration; Vomiting*

中文摘要

進入無需禁食的靜脈顯影電腦斷層掃描的世代

陳奕璇、曹子文、唐倩儂、伍永鴻

電腦斷層掃描靜脈造影劑給藥前至少要求4小時的禁食期一直是一種經驗性做法。這可增加患者不適、不利糖尿病控制，並限制了緊急情況下掃描安排的靈活性。緊急掃描需求數量的增加進一步加劇了這些影響，一些患者在等待掃描時段時需要反覆禁食。最近更新的國際指引指出，隨着造影劑安全性提高，不再需要常規禁食。在本文中，我們討論了當前的證據及其對我們本地實踐的影響。我們分享了我們逐步改變政策的方法最終使我們機構中所有符合條件的患者無需禁食，以及我們收集的安全數據。採用對比顯影掃描的無需禁食政策符合國際標準，且可行有益。

Correspondence: *Dr YS Chan, Department of Imaging and Interventional Radiology, Prince of Wales Hospital, Hong Kong SAR, China*
Email: juliannayschan@cuhk.edu.hk

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INTRODUCTION

Computed tomography (CT) has been commercially available since the 1970s and is one of the most widely used imaging modalities.[1] Conventional intravenous iodinated contrast emerged in the 1970s to 1980s, allowing for its application in CT, and is now an almost indispensable part of daily practice.[2] From then till now, the contrast agents we use have undergone important changes.

The intravenous contrast used in CT is iodine-based and is classified based on osmolality. High-osmolar contrast media (HOCM) was the first generation of iodinated intravenous contrast and was associated with a high rate of adverse events (5%-8% acute adverse reactions, which essentially encompassed all contrast reactions, and 1%-2% moderate non–life-threatening adverse reactions, which included faintness, vomiting [severe], urticaria [profound], facial edema, laryngeal edema and bronchospasm [mild]).[3] The majority of the chemotoxic effects are mainly related to the hyperosmolality.[3] Nausea and vomiting are common adverse effects with reported incidences of 4.58% and 1.84%, respectively.[4] Subsequently, since the 1990s, iso-osmolar contrast media (IOCM) and low-osmolar contrast media (LOCM), which are associated with an overall much lower risk of adverse reactions, have replaced HOCM. A retrospective review by Hunt et al[5] reported an adverse reaction rate of 0.153% for LOCM based on 298,491 doses, the prevailing majority of which were mild reactions not requiring treatment. The incidences of nausea and vomiting with the use of non-ionic contrast media (including IOCM and LOCM) are also substantially lower than their high-osmolar counterparts, with a reported incidence of 0.05% to 1.99% for nausea, and 0% to 0.36% for vomiting.[6]

Historically, since the days of HOCM use, fasting has been practised prior to intravenous contrast administration due to the established emetic side-effects of HOCM, based on the hypothesis that there is higher risk of vomiting with a full stomach and to reduce the risk of aspiration pneumonia. This practice has not been changed for more than two decades despite the shift to IOCM and LOCM, until very recently. To date, it is still a common practice to adopt a period of fasting prior to contrast media administration before CT scan in Hong Kong and worldwide.[7,8]

There has been increasing recognition of the low risk of gastrointestinal side-effects resulting from IOCM and LOCM administration irrespective of fasting time, as well as trials abolishing the empirical implementation of fasting prior to contrast CT. Lee et al[8] reviewed existing literature and found no case of aspiration in 2001 patients who underwent contrast CT with prior fluid intake. A prospective observational study involving 110,836 cases found no significant difference in the incidence of nausea and vomiting between solid food non-fasting and fasting groups.[9] Prospective randomised controlled trials, each involving more than 2000 patients, were carried out in both hospitalised patients and outpatients, and found no significant difference in incidence of nausea and vomiting between patients fasted for at least 4 hours and patients without fasting, and no case of aspiration pneumonitis was identified.[10,11] There has been an additional report of a statistically significant reduction in the incidence of nausea after changing to a non-fasting policy in an institution in Japan.[12]

Latest Guidelines on Preparatory Fasting

In 2018, the European Society of Urogenital Radiology (ESUR) published their Guideline on Contrast Agents (v10.0), which stated that 'fasting is not recommended before administration of low- or iso-osmolar non-ionic iodine-based contrast media or of gadolinium-based agents'.[13] Later and most recently in 2021, the American College of Radiology (ACR) published their latest Manual on Contrast Media, stating that 'given the potential for negative consequences due to fasting and a lack of evidence that supports the need for fasting, fasting is not required prior to routine intravascular contrast material administration', with additional special consideration required for patients undergoing conscious sedation.[14]

Local Practice

Currently in Prince of Wales Hospital, the contrast agents used include iohexol 300 and 350 (LOCM), and iodixanol (IOCM), all of which have a well-established safety profile and are known to have a low risk of nausea and vomiting. As per department protocol of the Department of Imaging and Interventional Radiology at Prince of Wales Hospital, patients attending the department for contrast-enhanced CT were previously required to fast for at least 4 hours prior to study, unless in emergencies or other limited special considerations. The fasting status of hospitalised patients would be confirmed by the ward, and outpatients would receive written instruction to fast before the appointment.

A PRACTICAL APPROACH TO POLICY CHANGE: LOCAL EXPERIENCE

With the significant discrepancy between the fasting policy between Prince of Wales Hospital and international standards, we saw a pressing need to change our clinical practice. In view of the potential impact of policy change in terms of logistics, and potential doubts or confusion from clinical departments in initial implementation, we adopted a stepwise approach to policy change, combined with ongoing data collection to consolidate the local safety profile of contrast media use under the new policy. The policy change was implemented in four phases (Figure 1).

Phase 1: Preparatory Phase

We reviewed the potential practical issues to the policy change. While a generic implementation of the non-fasting policy would be convenient, we saw that there would be circumstances and specific indications where fasting would still be required. As there was no clear consensus statement or guideline detailing exclusion criteria to non-fasting policy, we decided on a list of exclusion criteria based on consensus opinion of specialists from our local institutes (Table 1).

We gathered data on the fasting time and any occurrence of vomiting after contrast scanning for the patients coming to the radiology department at Prince of Wales Hospital for 25 working days through a questionnaire filled in by attending radiographers and nurses. The electronic patient record of the patients who experienced vomiting and their available subsequent chest radiographs were reviewed to identify any aspiration pneumonia complications. This served to establish a baseline of our performance and compile a local safety profile of contrast media use for CT. After confirming a comparable incidence of vomiting and aspiration pneumonia to international published data, we proceeded with our pilot scheme, continuing to collect data through all four phases.

Table 1. Local exclusion criteria for non-fasting policy in Prince of Wales Hospital.

1.	Ongoing, planned, or requirement for sedation/anaesthesia
2.	Other indications for fasting not due to contrast use, e.g., preparation for potential intervention/surgery
3.	Patients with increased risk of aspiration
4.	Paediatric patient <6 years old
5.	The examination is to assess for subtle gallbladder pathology
6.	Patients undergoing computed tomography colonography and enterography

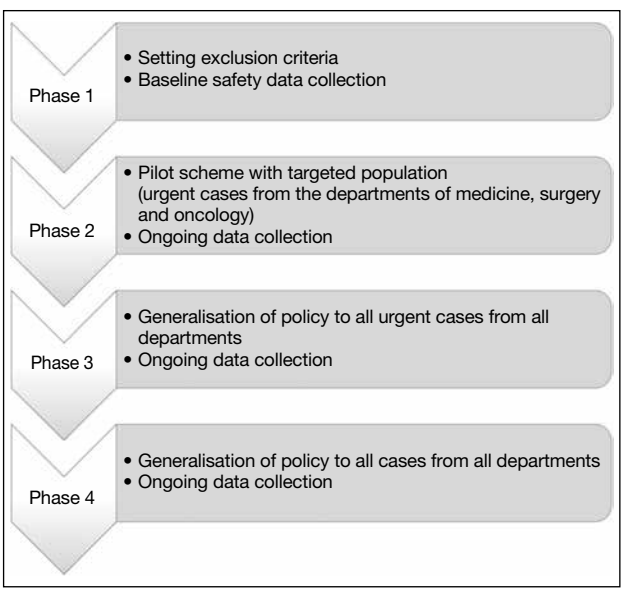

Figure 1. Action plan of policy change towards abolishment of preparatory fasting for contrast-enhanced computed tomography in Prince of Wales Hospital.

Phase 2: Pilot Scheme

We identified the departments of medicine, surgery and oncology at Prince of Wales Hospital as the three main sources of referrals to the radiology department for contrast-enhanced CT. A pilot scheme was then implemented with these three departments, during which the referred eligible patients (i.e., those not under the pre-set exclusion criteria) undergoing urgent contrast-enhanced CT were not required to fast prior to examination.

Phase 3: Generalisation of Non-fasting Policy to Urgent Cases

Subsequent to the pilot scheme, which was well-received with smooth operation, we proceeded with Phase 3, which was generalisation of the non-fasting policy to all urgent cases from all departments. The eligible patients referred from all departments undergoing urgent contrast-enhanced CT were not required to fast prior to examination.

Phase 4: Generalisation of Non-fasting Policy to All Cases

After allowing for a period of familiarisation of all departments with the new policy, we entered Phase 4,

extending the non-fasting policy to all cases, irrespective of urgent or elective setting. Previously, all patients booked for elective contrast-enhanced CT would receive fasting instructions. After the new policy was enforced, newly booked patients would no longer receive fasting instructions unless they fell into the exclusion criteria. No specific instructions were given to previously booked patients who had an appointment date after the new policy launch in order to avoid unnecessary confusion. For previously booked patients who arrived for contrast-enhanced CT without adequate fasting but who were not required to fast under the new policy, the scans were performed without delay.

Establishing a Local Safety Profile for Intravenous Contrast for Computed Tomography

The same duration (25 working days) and methods of data collection (questionnaire, electronic patient record, and chest radiograph review) were applied to Phases 2 through 4.

A total of 4357 attendances were recorded during our data collection through the four phases. There was a steady increase in the proportion of non-fasted attendances (Figure 2). The incidence of vomiting remained low. There was a total of six patients who vomited (0.13%), all of whom had fasted and did not have documented clinical or radiological evidence of aspiration pneumonia. A total of 594 patients were non-fasted and no vomiting occurred (Table 2).

DISCUSSION

Internationally, there is a shifting paradigm towards abolishment of routine preparatory fasting before intravenous contrast administration for CT scans. The recent updates in the ESUR guidelines and the ACR contrast manual provide a clear new international standard. There is also abundant evidence and international data confirming the safety profile of use of IOCM and LOCM, which are the agents used locally. Our experience with converting to a non-fasting preparation for contrast-enhanced CT is concordant with the findings

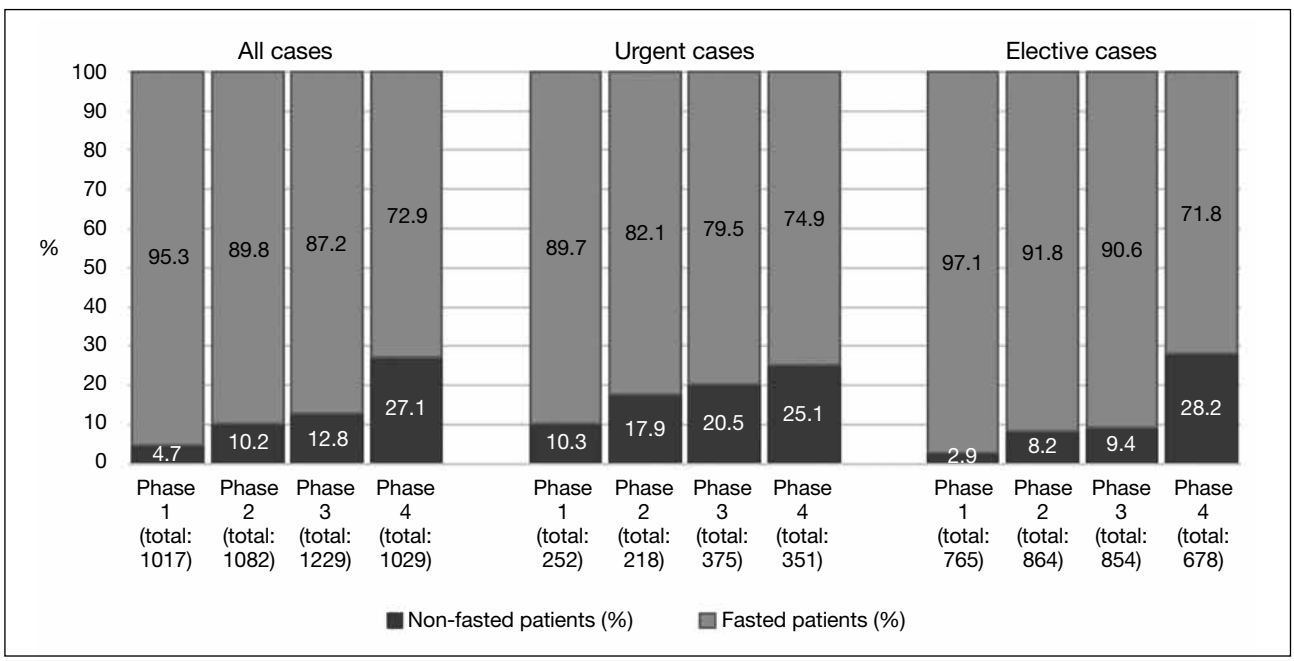

Figure 2. Distribution of fasting preparation among patients through the four phases.

Table 2. Number of cases with vomiting by fasting status in each data collection phase.

	Phase 1	Phase 2	Phase 3	Phase 4	Cumulative
Fasting cases with vomiting	3	2	1	0	6
Non-fasted cases with vomiting	0	0	0	0	0
Total cases with vomiting	3	2	1	0	6

Table 3. Potential disadvantages of universal preparatory fasting.

1.	Causes patient discomfort, with potential higher risk of nausea and vomiting, and may cause irritability and uncooperativeness
2.	Impacts glucose level and medication titration of diabetic patients
3.	Induces catabolic state in vulnerable patients
4.	Causes dehydration, which increases risk of contrast nephropathy and exacerbates the negative consequence of vomiting
5.	Decreases the flexibility of scan arrangement in urgent settings
6.	Delayed scans may prolong hospitalisation, bed occupancy and delay necessary treatment

of published studies, with a low incidence of vomiting and no occurrence of aspiration pneumonia. From a very early study by Oowaki et al[15] to a recent study by Tsushima et al,[12] longer fasting times were found to be associated with an increase in the adverse effect of nausea.[15] There are a number of potential disadvantages of universal preparatory fasting, which are summarised in Table 3. Fasting creates patient discomfort, disturbs nutritional balance in the weak, especially older adult and oncology patients, and potentially causes negative impact on diabetic control and medication titration. Fasting may also create dehydration, which is contradictory to the need of adequate hydration for prevention of contrast nephropathy, and further exacerbates the negative fluid balance should vomiting occur. For inpatients, dehydration can be avoided by administration of intravenous fluid. For outpatients, however, intravenous fluid is not a reasonable option. At an administrative level, the need for consideration of fasting duration also reduces flexibility in appointment arrangement. Empirical adherence to preparatory fasting can lead to unnecessary delays in management, as well as prolonged hospitalisation and bed occupancy. With the compelling evidence, a change in local practice is imperative.

Practically, the implementation of the non-fasting policy is not as simple as a one-off policy change, for two main reasons. First, it is a deeply rooted concept well-accepted by clinicians in Hong Kong that fasting has a protective effect against contrast-induced emesis and lowers the risk of aspiration pneumonia. It is also a convenient practice as an admission order for the majority of inpatients to avoid delay in investigations or potential procedures. However, this practice is not in the best interest of all patients, especially for the weak and fragile. In our experience, many inpatients underwent repeated episodes of prolonged fasting while waiting for urgent contrast-enhanced CT examinations. Due to rising demand despite limited resources, this would be seen more frequently if the policy had not been changed. Second, it is a general statement that fasting is no longer required prior to contrast administration. There are no specific exclusion criteria stated by ESUR guidelines, whereas the ACR manual on contrast media touched upon that 'for patients receiving conscious sedation, anaesthesia guidelines should be consulted'.[13,14] Despite the lack of specific instructions, it is imaginable that there are specific scenarios where fasting may be necessary or have added benefits. We devised our set of exclusion criteria locally based on the consensus opinion of our institutes' specialists (Table 1). Each institution may consider a variation of the exclusion criteria tailored to the demographics of their patients. Our exclusion criteria have two main bases: (1) There are patients at higher risk of aspiration; and (2) There are specific needs for fasting for image optimisation and interpretation.

Specific to certain risk groups, fasting may still be required. Adding to the ACR manual's note on patients undergoing conscious sedation, we expanded the exclusion to all patients receiving sedation/anaesthesia in accordance with anaesthesia guidelines for preoperative fasting, and for those expecting or potentially requiring sedation/anaesthesia in order to avoid potential delay in management. A similar rationale was used for patients expecting to undergo intervention or surgery. On the other hand, there is a group of patients who are inherently at higher risk of aspiration, e.g., those with bulbar palsy with impaired gag reflexes, and those with impaired consciousness levels. In these groups, the preparatory fasting aims mainly to reduce the volume of aspirate should the rare event of vomiting occur, as they are more vulnerable to the aftermath of vomiting. Another group of patients requiring special consideration is the paediatric population. ESUR guidelines[13] and the ACR contrast manual[14] did not specify a need for special consideration for the paediatric population. Compared with the adult population, there are, however, fewer published data evaluating the risk of vomiting with contrast media use. A small study by Ha et al[16] involving 864 patients aged from 1 day to 19 years (mean age = 8.4 ± 5.7 years) found

the incidence of vomiting was 2.1% in the study group with no occurrence of aspiration pneumonia. In Prince of Wales Hospital, we used the age of 6 years as a cut-off for the need for fasting in the paediatric population, based on the need for sedation prior to CT for patients under this age as suggested by our paediatric radiologist.

Specific to the potential impact on image interpretation, there has not been any specific dedicated study to evaluate the effect of a non-fasting policy on image quality. The gallbladder is known to distend with fasting, which may allow for better evaluation of subtle gallbladder pathology, e.g., small polyps. Gross changes in the gallbladder, e.g., acute cholecystitis, do not require fasting preparation for assessment. In addition, the duration of fasting may not necessarily correlate with the degree of gallbladder distension. We therefore only limited exclusion to indications to look for subtle gallbladder pathology. CT enterography and colonography require bowel preparation for optimal image quality and accurate image interpretation and were therefore excluded from the non-fasting policy. So far, with these exclusion criteria in place, we did not encounter any case where the interpretation has been hindered by the non-fasting state.

Combining international guidelines and local consensus opinion, we have implemented the non-fasting policy to all patients undergoing iodinated contrast-enhanced CT examinations in the radiology department with a set of limited exclusion criteria. Through a stepwise approach, we allowed time for adaptation and familiarisation by the clinical departments, and the policy has been met with a positive response with smooth transition. To our knowledge, preparatory fasting is still practised in many local institutions. We hope to advocate the implementation of a non-fasting policy for eligible patients across centres in order to provide patient-centred and evidence-based care, adhering to international standards.

CONCLUSION

Non-fasting contrast-enhanced CT is a safe and internationally recognised practice supported by evidence and international guidelines. Our experience showed a comparable safety profile with that of published studies in terms of low incidence of vomiting and aspiration pneumonia. Policy implementation is achievable through a stepwise approach with need for consideration of pre-set exclusion criteria.

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