

Standard-dose versus low-dose multidetector computed tomography examinations in patients with uncontrolled chronic rhinosinusitis

A randomized, controlled trial

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Abstract

Background: Multidetector computed tomography (MDCT) images for rhinosinusitis may have a risk of radiation hazards. Reduction in radiation dose may lead to a compromise in quality of MDCT images and have chances of postoperative complications.

Objective: The aim of the study was to test the applicability of low-dose MDCT protocols for decision-making of sinus surgeries of patients with uncontrolled chronic rhinosinusitis.

Design: Randomized, double-blind (patients and evaluators blind), controlled, trial.

Setting: People's Hospital of Guanghan, China.

Patients: A total of 288 patients with clinically confirmed uncontrolled chronic rhinosinusitis were subjected to randomization (1:1 ratio).

Interventions: Patients were subjected to low-dose preoperative protocols of MDCT ($n=144$; ldMDCT group) or standard-dose preoperative protocols of MDCT ($n=144$; sdMDCT group).

Outcome measures: Image analysis was performed by the workstation. Lund-Mackay score, modified Lund-Mackay score, estimated radiation exposure, and surgical complications were evaluated for each patient. The χ^2 independent test or 2-tailed paired t test were performed for statistical analysis.

Results: The preoperative MDCT images for standard-dose protocol had better quality than low-dose protocol ($P < .001$, $q = 4.57$). The area of images that give confidence for sinus surgery at one time was higher for standard-dose MDCT protocol technique than low-dose MDCT protocol method. Patients of ldMDCT group with large growth of nasal polyps ($P = .03$, $q = 5.35$) and complete opacification of sinuses ($P = .03$, $q = 7.94$) had complications after sinus surgeries. Either low-dose or standard-dose MDCT protocol was performed, the experience of otolaryngologist had decreased complication after surgeries.

Conclusion: Preoperative low-dose MDCT should be used for diagnosis of uncontrolled chronic rhinosinusitis for decision making of sinus surgeries.

Level of Evidence: III.

Trial registration: researchregistry4264 dated 1 March 2016 (www.researchregistry.com).

Abbreviations: ALARA principle = as low as reasonably achievable principle, CONSORT = consolidated standards of reporting trials, FEV₁ = the forced expiratory volume in 1 s, k = Kappa statistic coefficient, ldMDCT = low-dose multidetector computed tomography, MDCT = multidetector computed tomography, PEF = peak expiratory flow, q = critical value for Tukey post hoc test, SACOTSS = the self-administered Computerized Olfactory Testing System score, sdMDCT = standard-dose multidetector computed tomography, STARD = standards for the reporting of diagnostic accuracy studies, STROCSS = strengthening the reporting of cohort studies in surgery.

Keywords: multidetector computed tomography, nasal polyps, paranasal sinuses, radiation, radiation dosage, rhinosinusitis

Editor: Heye Zhang.

The authors have no funding and conflicts of interest disclose.

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Medicine (2018) 97:50(e13137)

Received: 19 July 2018 / Accepted: 12 October 2018

<http://dx.doi.org/10.1097/MD.00000000000013137>

1. Introduction

Generally, chronic rhinosinusitis is diagnosed by subjective symptoms.^[1] Nowadays, patients with chronic rhinosinusitis are diagnosed by endoscopic^[2] and radiological images^[1] following sinus surgeries (as treatment option).^[2] Preoperative multidetector computed tomography (MDCT) is necessary for the success of sinus surgery^[1] because only MDCT is provided detailed images of the sinuses that facilitate the otolaryngologist for areas of the pathogenesis.^[1]

MDCT for rhinosinusitis may lead to a risk of radiation hazards. Radiation dose from a single standard-dose of MDCT examination is almost the same as annual radiation from cosmic radiation and natural sources.^[3] Although several attempts are made to reduce the dose of MDCT for the screening of disease(s), reduction in radiation

dose may lead to a compromise in the quality of MDCT images.^[2]

Overall, standard-dose preoperative MDCT protocol is preferred for sinus surgeries.^[2] It provides an exact quantification of bony matters, minimizes diagnostic errors, and has 90% consistency of intraoperative and radiological findings but has high radiation dose risk to patients.^[2] Therefore, it is considered in the conditions when polyps below the middle turbinate only.^[4]

Preoperative low-dose MDCT is also applied for sinus surgery because this surgery is relatively safe surgery but has the issue of consistency of intraoperative radiological findings.^[2] Moreover, low-dose protocols could be used for sinus surgeries in the cases when patients have no polyps or have small changes in nasal endoscopy^[4] because if sinus surgery performed with reference to low-dose protocols there would be chances of postoperative asthma and the polyp score.^[5] Postoperative complications affected by the other factors like the experience of surgeons, length of surgeries, and the demographic characters of patients.^[6]

Even good results with MDCT images, surgeons very often repeat MDCT images ignoring the ALARA (As Low As Reasonably Achievable) principle.^[1] In such conditions, a radiation dose of standard-dose multidetector MDCT may create issues to the lens, thyroid gland, and the other radio-sensitive organs of patients during diagnosis of chronic rhinosinusitis.^[7,8] Therefore, there is need of a reduction in standard radiation dose of MDCT for preoperative diagnosis of chronic rhinosinusitis for decision-making of sinus surgeries.

The objective of the study was to test the applicability of low-dose MDCT protocols for decision-making of sinus surgeries of patients with uncontrolled chronic rhinosinusitis at level III of evidence without conflict of interest.

2. Materials and methods

2.1. Drugs and reagents

Propofol (Diprivan) was purchased from AstraZeneca, China. Remifentanyl (Ultiva) was purchased from Glaxo SmithKline Pharmaceuticals Ltd., China.

2.2. Ethical consideration and consent to participate

The study had been registered in the Research registry (www.researchregistry.com), UID No.: researchregistry4264 dated March 1, 2016. The protocol (PHGH/CL/17/16 dated February 25, 2016) had been approved by the People's Hospital of Guanghan review board. The study had adhered to the law of China, standards for the reporting of diagnostic accuracy studies (STARD) guidelines, the consolidated standards of reporting trials (CONSORT) guidelines and 2013 Declarations of Helsinki.^[9] The work has been reported in line with strengthening the reporting of cohort studies in surgery (STROCSS) criteria.^[10] An informed consent form had been signed by all the enrolled patients or their relatives (legally authorized person) for radiology, anesthesiology, surgeries, and publication of the study including any personal images and information (if any) in all formats (hard and/or electronic) irrespective of time and language.

2.3. Inclusion criteria

All patients admitted to the department of otolaryngology at the People's Hospital of Guanghan, China from March 7, 2016 to

February 12, 2018 with uncontrolled (nocturnal symptoms and need for rescue treatment) and chronic rhinosinusitis were subjected to a preindex test (prescanning procedure).

2.4. Nasal endoscopy

A narrow tube with a tiny camera (ShenDa-J02203, nasal endoscope; Hangzhou Haizhu MIM Products Co., Ltd., China) had been inserted into the nose of patients by an otolaryngologist (minimum 3 years of experience) to perform a detailed examination inside nose and sinuses. The scoring of nasal polyps was made according to the Lildholdt's scale as 0: no polyposis, 1: soft growth only in the middle Meatus, 2: growth beneath the lower edges of the middle turbinate, and 3: large growth reaching the lower border of the inferior turbinate.^[2]

2.5. Nasal provocation test

One puff (0.1 mL) of Aspirin (25 mg/100 mL) was applied in both nostrils. Patients were observed 6 h after of the test and immediate response was measured by otolaryngologist.^[11]

2.6. Pulmonary function test

The forced expiratory volume in 1 s (FEV₁) and peak expiratory flow (PEF) had been measured by pulmonologists (minimum 3 years of experience). FEV₁ and PEF >80% were considered as a normal condition of pulmonary functions.^[12]

2.7. Olfactory function test

Patients were subjected to determine olfactory thresholds (score range: -6 to -2) using the self-administered computerized olfactory testing system by an otolaryngologist. The score of patients was classified as -6 to -4.05: normosmic, -4.05 to -2.05: hyposmic, and -2: anosmic.^[13]

Symptomatic patients whose pharmacological treatments were not successful and subjected to sinus surgery were only included in the study. Patients, age 18 years and above who had been signed an informed consent form were included in the trial.

2.8. Exclusion criteria

Patients with allergic rhinitis, no bilateral inflammatory changes, and bronchial asthma were excluded from the study. Patients, age below 18 years and did not sign an informed consent form were excluded from the study. Patients with FEV₁ and PEF <80%, no polyposis, and normosmic patients were excluded from the study.

The demographical characters of the enrolled patients are presented in Table 1.

2.9. Design of experiment

A total of, 288 patients were subjected to randomization (simple randomization, 1:1 ratio). The sample size was determined by OpenEpi 3.01-English (Open Source Epidemiologic Statistics for Public Health, USA) and found to be 144 for each group. The other factors, 2-sided confidence intervals were 95% ($\alpha=0.05$), outcomes in both groups were 95%, the risk ratio was one, and power based on normal approximation was 1.073%. Patients allocation was made by a prefilled envelope. The blinding (patients, surgeons, and evaluators blind) was performed by the institute themselves and maintained

Table 1
The demographical characters of the enrolled patients.

Characters		Group		Comparison between groups
		ldMDCT	sdMDCT	
		Low	Standard	
Protocol for preoperative MDCT				P
Sample size		144	144	—
Age, y	Minimum	19	20	.06
	Maximum	70	70	
	Mean ± SD	49.22 ± 10.55	50.72 ± 9.88	
Sex	Male	67 (47)	63 (44)	.72
	Female	77 (53)	81 (56)	
Body mass index, kg/m ²		22.45 ± 3.15	23.31 ± 4.47	.06
FEV ₁		83.57 ± 8.58	85.11 ± 9.15	.14
PEF		85.66 ± 6.88	87.88 ± 12.15	.06
*Liltholdt's scale	1	70 (49)	61 (42)	.25
	2	52 (36)	65 (45)	
	3	22 (15)	18 (13)	
Olfactory function	Hyposmic (SACOTSS: -4.05-2.05)	88 (61)	77 (53)	.23
	Anosmic (SACOTSS: -2)	56 (39)	67 (47)	
Previous sinonasal surgery	Yes	12 (8)	10 (7)	.83
	No	132 (92)	134 (93)	

Constant data were represented as a number (percentage) and continuous data were represented as mean ± SD.

FEV₁ = The forced expiratory volume in 1 s, MDCT = multidetector computed tomography, PEF = peak expiratory flow, SACOTSS = the Self-Administered Computerized Olfactory Testing System score. The χ^2 independent test and 2-tailed paired *t* test for categorical data and continuous data were used for statistical analysis, respectively.

A *P* < .01 was considered significant.

* 1: soft growth only in the middle Meatus, 2: growth beneath the lower edges of the middle turbinate, and 3: large growth reaching the lower border of the inferior turbinate.

Liltholdt's scale and olfactory function were performed by an otolaryngologist (minimum 3 years of experience).

throughout. CONSORT flow diagram of the study is presented in Figure 1.

2.10. MDCT examinations

Patients of low-dose multidetector computed tomography (ldMDCT) were subjected to low-dose preoperative protocols of MDCT (tube potential was 120 kVp and 40 mAs, detector configuration was 64 × 0.625 mm, pitch was 0.55, section thickness was 0.625, and gantry rotation time was 0.4 s)^[14] and Patients of sdMDCT (standard-dose multidetector computed tomography) were subjected to standard-dose preoperative protocols of MDCT (tube potential was 120 kVp and 100 mAs, detector configuration was 64 × 0.625 mm, pitch was 0.9, section thickness was 0.625, and gantry rotation time was 0.7 s).^[2] The scanner used was 128-slice ingenuity (Philips Healthcare, Chicago, IL).

2.11. Image analysis

Image analysis was performed by IntelliSpace Portal 7.0 workstation (Philips Healthcare, Chicago, IL). Images were reconstructed in 0.625 slice thickness and displayed as 2000 × 350 HU (level × width) and s-3 filter. Authors and otolaryngologist (blind regarding dose) were evaluated in coronal and axial images independently. Anatomical structures of the optical nerve (cranial nerve II) next to the sphenoid sinus, the anterior branch of the ethmoidal artery, lamina papyracea, and cribriform plate were evaluated. The image qualities were graded as, 1: unacceptable image quality, 2: many artifacts (poor image quality), 3: rare artifacts (moderate image quality), 4: good image quality, and 5: excellent image quality.^[2]

2.12. Lund-Mackay scoring

Lund-Mackay scoring system was used to measure the level of opacification in the paranasal sinuses.^[15] When inflammation

was not found in images, the score was given as 0. The other degrees of inflammation was scored as 1. If 100% changes were observed in the sinus, then score was given 2. For the ostiomeatal complex scoring, 0: not obstructive, 1: inflammation, and 2: obstructive. The range of score for each side is 0 to 12, with the range for a total score of 0 to 24¹.

2.13. Modified Lund-Mackay scoring

It was scored as 0: no inflammation of the sinuses, 1: inflammation occupied up to one third part of sinuses, 2: inflammation observed in one third-to two-thirds part of sinuses, 3: inflammation observed in more than two-thirds part of sinuses but not complete opacification, and 4: complete opacification of sinuses. For the ostiomeatal complex scoring, 0: not obstructive, 1: partially obstructive, and 2: completely obstructive. The range of score for each side is 0 to 24, with the range for a total score of 0 to 48.^[16]

2.14. Sinus surgery

Patients who planned for sinus surgery were subjected to intravenous propofol (maximum 350 mg) by anesthesiologist(s). For positive end-expiratory pressure, laryngeal mask (Ambu, Xiamen, China) was used. All patients lay in reverse Trendelenburg position at 25° inclinations (the angle was measured by Android application, 'Compass'). Otolaryngologists have performed all surgeries. Remifentanyl was given to patients during surgery to relieve pain and as an adjunct to an anesthetic.^[17]

2.15. Beneficial score analysis

Beneficial score for MDCT was defined as the difference between the sinus surgeries without complications and the sinus surgeries with complications. It was derived by a decision curve analysis

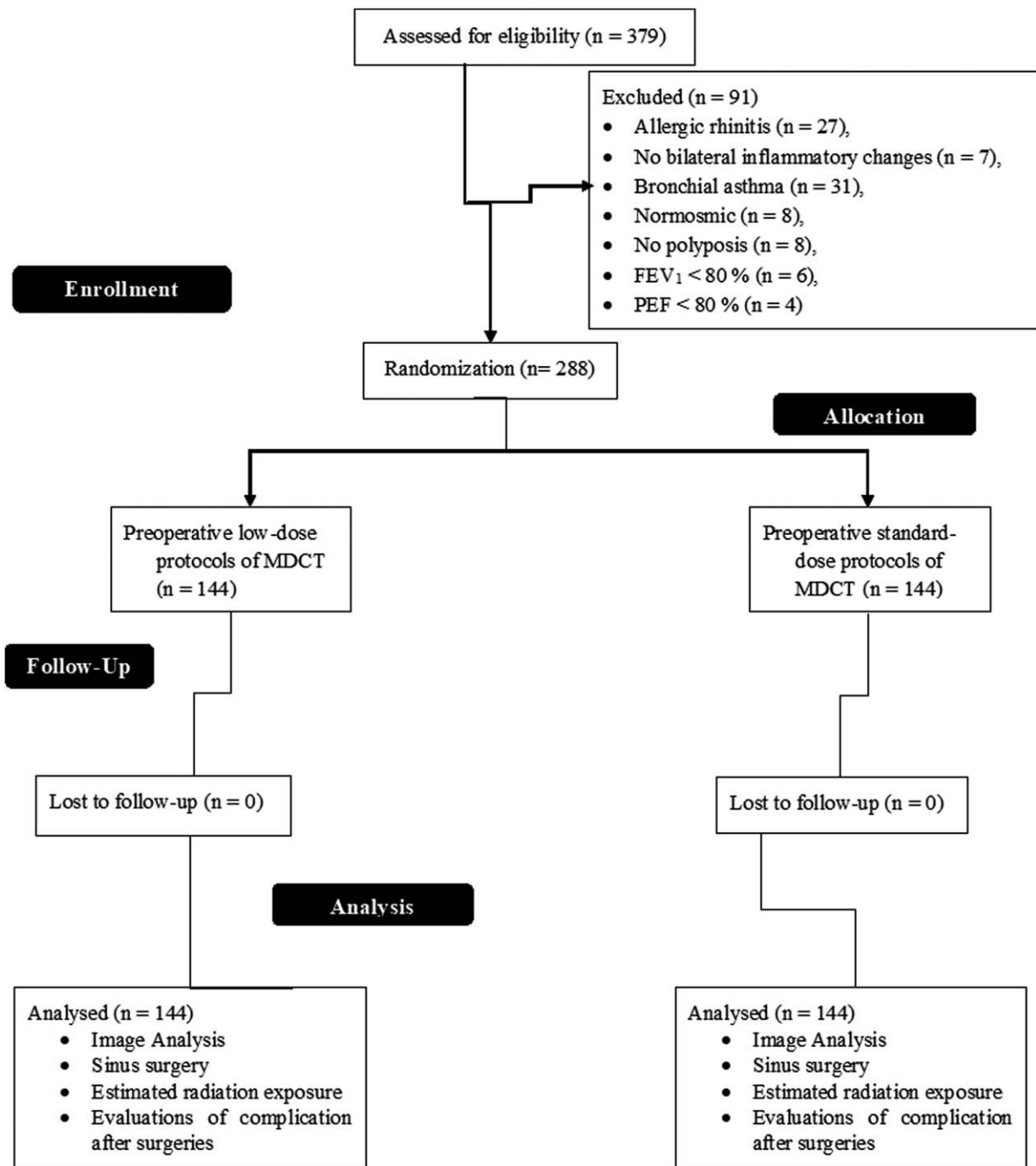


Figure 1. CONSORT flow diagram of the study. Intention-to-treat analysis method. Confidence intervals were 95% ($\alpha = 0.05$), outcomes in both groups were 95%, the risk ratio was one, and power based on normal approximation was 1.073%. MDCT = multidetector computed tomography.

method (Eq. 1 and 2):^[18]

$$\begin{aligned} & \text{Benefit score for adopted MDCT technique} \\ & = p - (Q \times \text{The risks for overtreatment and} \\ & \text{undertreatment}) \end{aligned} \quad (1)$$

The risk for overtreatment and undertreatment

$$= \frac{\text{The image qualities above it the sinus surgery could be performed}}{5 - \text{The image qualities above it the sinus surgery could be performed}} \quad (2)$$

where,

$$P = \frac{\text{Sinus surgeries rate without complications and with acceptable minor complications}}{\frac{\text{Numbers of sinus surgeries without complications and with acceptable minor complications in adopted MDCT technique}}{\text{Numbers of patients subjected to sinus surgery in adopted MDCT technique}}}$$

$$Q = \frac{\text{Sinus surgeries rate with unacceptable complications}}{\frac{\text{Numbers of sinus surgeries with unacceptable complications in adopted MDCT technique}}{\text{Numbers of patients subjected to sinus surgery in adopted MDCT technique}}}$$

Table 2
Preoperative image quality for decision making of sinus surgery.

No. of patients subjected to diagnosis	Group		Comparison between groups	
	ldMDCT	sdMDCT	P	q
Scoring for image quality				
1	17 (12)	1 (1)	<.001	4.57
2	29 (20)	26 (18)		
3	37 (26)	45 (31)		
4	46 (32)	55 (38)		
5	15 (10)	17 (12)		

Data were represented as number (percentage).
Two-tailed paired *t* test following Tukey post hoc test was used for statistical analysis.
A *P* < .01 and *q* > 4.12 were considered significant.
1: unacceptable, 2: poor, 3: moderate, 4: good, and 5: excellent.
Inter-rater agreement: Good (*k* = 0.8).

The complication for sinus surgery was defined as reporting of postoperative bleeding, rectus muscle damage, cerebrospinal fluid rhinorrhea, a breach of the lamina papyracea, retrobulbar hematoma, and orbital cellulitis.

2.16. Estimated radiation exposure

The dose-length product was recorded. Using Eq. 3, radiation exposure was estimated.^[19]

$$\text{Radiation exposure} = \text{Dose length product} \times k \quad (3)$$

where:

k : Conversion factor = 0.0022 mSv.

2.17. Statistical analysis

InStat (vWindow), GraphPad, IL, USA was used for statistical analysis. The χ^2 Chi-square independent test^[2] for categorical data and 2-tailed paired *t* test^[14] or Mann–Whitney test (unpaired data)^[20] was used for continuous data to perform for statistical analysis. The results before surgeries were considered significant at 99% of confidence level and those of after surgeries were considered significant at 95% of confidence level (because drug treatment was given). Tukey test was used for post hoc analysis considering critical value [*q*] > 3.33 (for 95%) or 4.12 (for 99% confidence level) as significant. Intention-to-treat method of analysis was preferred. Inter-rater agreement was evaluated by Kappa statistic (*k*: 0.81–1: excellent, *k*: 0.61–8: good, *k*: 0.41–0.6: moderate, *k*: 0.21–0.4: fair, and *k* < 0.2: poor).

3. Results

There was a good inter-rater agreement regarding image quality for decision making of sinus surgery (*k* = 0.8) and moderate agreement for evaluation of surgical complaints in patients (*k* = 0.79).

The preoperative image for optical nerve (cranial nerve II) next to the sphenoid sinus, the anterior branch of the ethmoidal artery, lamina papyracea, and cribriform plate for standard-dose MDCT had better quality than low-dose MDCT (*P* < .001, *q* = 4.57; Table 2).

Moderate quality images of standard-dose MDCT had provided sufficient information and good quality images of low-dose MDCT had not provided sufficient information. The area of images that give confidence for sinus surgery at one time was higher for standard-dose MDCT technique than low-dose MDCT protocol (Fig. 2).

The effective radiation dose for standard-dose MDCT protocol (0.79 ± 0.025 mSv) was eleven times higher than that of low-dose MDCT protocol (0.075 ± 0.003 mSv).

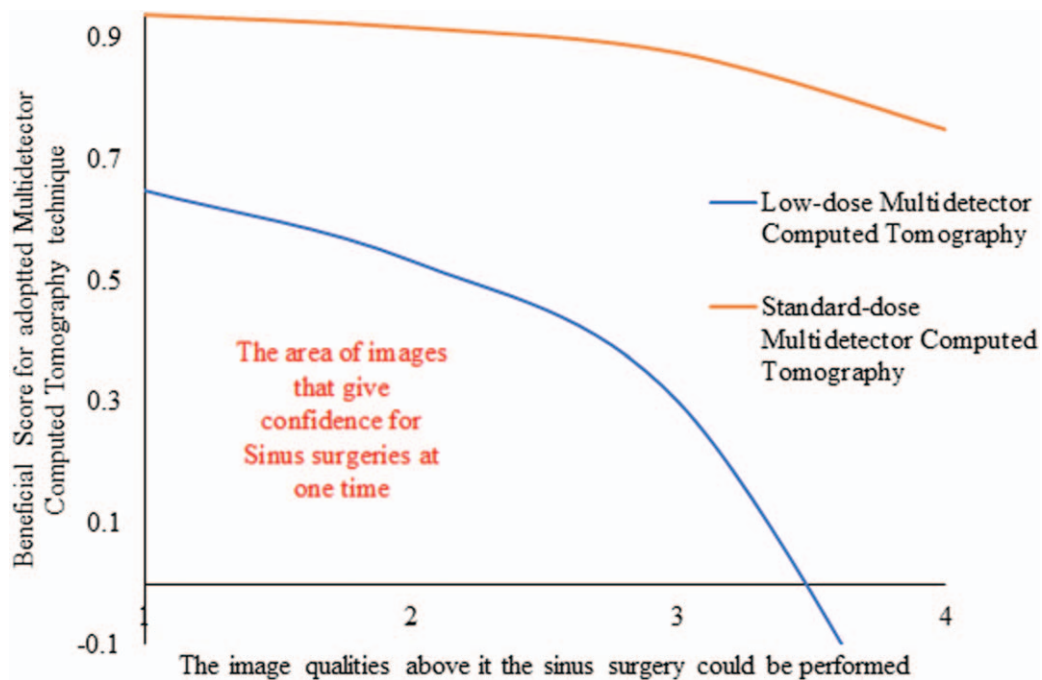


Figure 2. Beneficial score analysis for adopted preoperative MDCT. Moderate quality images of standard-dose MDCT had provided sufficient information and good quality images of low-dose MDCT had not provided sufficient information. Inter-rater agreement: Good (*k* = 0.8). MDCT = multidetector computed tomography.

Table 3**Complication after surgeries.**

Characters	[§] Complications reported		Comparison between groups	
	ldMDCT group	sdMDCT group	<i>P</i>	<i>q</i>
	Low	Standard	—	—
Gender				
Male	2 (3)	1 (2)	.87	N/A
Female	5 (7)	2 (2)	.64	N/A
Age, y				
18–39	2 (10)	1 (7)	.89	N/A
40–60	9 (9)	6 (6)	.69	N/A
>60	3 (15)	1 (4)	.52	N/A
Lildholdt's scale				
1	3 (4)	1 (2)	.78	N/A
2	5 (10)	2 (3)	.52	N/A
3 [#]	10 (45)	1 (6)	.03	5.35
Olfactory function				
Hyposmic	5 (6)	1 (1)	.61	N/A
Anosmic	9 (16)	1 (1)	.14	N/A
Previous sinonasal surgery				
Yes	0 (0)	0 (0)	N/A	N/A
No	1 (1)	1 (1)	0.99	N/A
*Lund-Mackay scoring				
1–6	3 (2)	1 (1)	.83	N/A
7–12	4 (3)	1 (1)	.75	N/A
13–18	9 (6)	1 (1)	.39	N/A
19–24	17 (12)	1 (1)	.08	N/A
†Modified Lund-Mackay scoring				
1–12	4 (3)	1 (1)	.75	N/A
13–24	6 (4)	1 (1)	.59	N/A
25–36	13 (9)	2 (1)	.24	N/A
[#] 37–48	21 (19)	1 (1)	.03	7.94
‡Surgeon skill (year experience)				
<1 [#]	17 (12)	3 (2)	.01	5.71
[#] 1–3	12 (8)	2 (1)	.01	4.79
>3	5 (3)	1 (1)	.1	N/A
Requirements of extra sinonasal surgery				
Yes	2 (13)	1 (10)	.81	N/A
No	5 (4)	1 (1)	.09	N/A
The use of a microdebrider				
Yes	2 (10)	2 (18)	.69	N/A
No	3 (2)	3 (2)	.98	N/A

Data were represented as number (percentage).

Hyposmic: SACOTSS: –4.05 to 2.05.

Anosmic: SACOTSS: –2.

SACOTSS: The Self-Administered Computerized Olfactory Testing System score.

* Score: 0 to 2, the ostiomeatal complex scoring: 0 to 2, total score: 24.

† Score: 0 to 4, the ostiomeatal complex scoring: 0 to 2, total score: 48.

‡ Residential doctors were considered as experience <1 year.

§ Postoperative bleeding, rectus muscle damage, cerebrospinal fluid rhinorrhea, a breach of the lamina papyracea, retrobulbar hematoma, and orbital cellulitis.

Significant problem with ldMDCT technique.

Two-tailed paired *t* test (paired) or Mann–Whitney test (unpaired) following Tukey post hoc test was used for statistical analysis.

A *P* < .05 and *q* > 3.33 were considered significant.

For statistical analysis, the complication was considered as 1 and normal condition was considered as 0.

N/A = Not applicable.

Inter-rater agreement: Moderate (*k* = 0.79).

On the basis of MDCT image analysis, patients who had one and more than one Lund-Mackay score, one and more than one modified Lund-Mackay score were decided to perform sinus surgery by an otolaryngologist. Twenty patients of ldMDCT and 11 patients of sdMDCT had required the use of a microdebrider. Patients of ldMDCT with large growth of nasal polyps (*P* = .03, *q* = 5.35) and complete opacification of sinuses (*P* = .03, *q* = 7.94) had complications after sinus surgeries. Either low-dose or standard-dose MDCT was performed, the experience of otolaryngologist had decreased complication after surgeries (Table 3).

Standard-dose MDCT had high-quality diagnostic performance than low-dose MDCT (Table 4).

4. Discussion

Although preoperative MDCT had been adopted by otolaryngologist after the performance of the preindex test in the trial for

diagnosis of important bony landmarks, the study had found 7% patients in sdMDCT group and 28% in ldMDCT group with unacceptable complication(s) after sinus surgeries. Functional sinus surgeries have high incidences of minor (21%) and major (1.5%) complications.^[21] MDCT would be minimized complications during surgeries and after surgeries.^[22] In respect to preoperative diagnostic imaging technique adopted in sinus surgeries, the trial reported low numbers of complications for standard-dose MDCT protocol and high numbers of complications for low-dose MDCT protocol with respect to available trails.

For the detectability of key structures and confidence of surgeries, standard-dose MDCT had a better quality of images but had eleven times higher radiation exposure than low-dose MDCT. The radiation dose for patients of sdMDCT group was higher than the Cone Beam Computed Tomography (0.79 ± 0.025 mSv vs 0.2 mSv). However, the radiation dose for patients of ldMDCT group was lower than the Cone Beam Computed

Table 4**Diagnostic performance of preoperative multidetector Computed Tomography techniques.**

Scoring for image quality	Group		Comparison between groups	
	ldMDCT	sdMDCT	<i>P</i>	<i>q</i>
Numbers of patients subjected to Sinus surgeries	144	144		
Numbers of sinus surgeries without complications and with acceptable minor complications	104 (72)	138 (95)	<.001	9.97
Numbers of sinus surgeries with unacceptable complication(s)	40 (28)	7 (5)		
Sinus surgeries rate without complications and with acceptable minor complications	0.72	0.95		
Sinus surgeries rate with unacceptable complications	0.28	0.05		
Required of extra sinonasal surgery	15 (10)	10 (7)	.03	1.81

Data were represented as number (percentage).

Two-tailed paired *t* test following Tukey post hoc test was used for statistical analysis.

A *P* < .05 and *q* > 3.33 were considered significant.

For statistical analysis Sinus surgeries with unacceptable complication(s) were considered as 1 and without complications and with acceptable minor complications were considered as 0.

Inter-rater agreement: Good (*k*=0.8).

Tomography (0.075 ± 0.003 mSv vs 0.2 mSv).^[2,3] Radiation dose is an important issue for diagnostic modalities.^[2,8,24] The mean radiation dose faced by patients of sdMDCT (calculated as per ALARA protocol^[4]) would be created eye lens opacification and malignant tumor of thyroid gland of patients in future because only 6–14 Gy radiation dose is quite enough to form cataract in human^[24] and 0.0075 Gy radiation exposure may be caused malignant neoplasms of thyroid.^[8] With respect to a radiation dose of MDCT techniques adopted in the trial, preoperative low-dose MDCT protocols with acceptable image quality would be the safest option for sinus surgeries.

In the trial, the experienced otolaryngologist had less numbered patients with complications than inexperienced otolaryngologist irrespective of preoperative MDCT protocol adopted (6 vs 34, *P* < .001, *q* = 8.59). Moreover, patients who had diagnosed large growth of nasal polyps and complete opacification of sinuses diagnosed by low-dose MDCT images only had complications. These results were in line with available studies.^[1,2,19] Patients with severe uncontrolled chronic rhinosinusitis are required standard-dose MDCT following sinus surgeries.^[1,2,6,22,25] In consideration of the risk of complications, the trial suggested, the adaptation of standard-dose protocols of MDCT for sinus surgeries when severe complications have found by nasal endoscopy and olfactory function test.

The study was level III of the evidence-based human trial that followed CONSORT and STARD guideline. The previous studies are multiple analyses (level III, sample population: 997),^[6] phantoms and cadaveric heads study (sample size: 83 vs 52, level II),^[2] phantoms studies (level II),^[7,20] simulated study (sample size 93, level II),^[1] comprehensive review (level III),^[8,17,21,22] and a pilot study (sample size 180, level II).^[13] Reviews and multiple analyses have lack of experiment and limitation of languages.^[21] Phantoms and simulated studies have limitations of demographic characters for the inclusion objects^[2] and results are not totally generalized.^[20] In respect to the design of the experiment, the study was justified its finding.

In the limitations of the study, for examples, the radiation dose calculated in the study is not generalized. It would be different for different manufactured MDCT. The patient size and weight factor were not considered for evaluation of complications. The justification for the same is sinus anatomy is almost similar in all adult patients. Large numbers of female and small numbers of male patients were enrolled in the study (*P* = .03). The study was performed without 'gold standard'. The cost analysis and length of surgeries were not evaluated. Prospective studies are required to overcome limitations.

5. Conclusion

Preoperative standard-dose multidetector Computed Tomography facilitates accurate evaluation of sinus surgeries but may have an unavoidable risk of high radiation dose exposure. Preoperative low-dose multidetector Computed Tomography also enables diagnosis of sinus surgeries but may have complications after surgeries. Complications could be resolved by experienced hands. A randomized controlled trial concluded that preoperative low-dose multidetector Computed Tomography should be used for diagnosis of uncontrolled chronic rhinosinusitis for sinus surgeries except for the high risk of complications.

Acknowledgments

Authors are thankful for the medical and non-medical staff of the first clinical college, Medical College of Nanchang University, Nanchang, China and the People's Hospital of Guanghan, Guanghan, China.

Author contributions

All authors read and approved the manuscript for publication. Wei Huang had drafted, review, and edited the manuscript for intellectual content. Jian Ye was project administrator and contributed to data curation and formal analysis. Xinli Guan contributed to the conceptualization of the study and methodology.

Conceptualization: Xinli Guan.

Data curation: Jian Ye.

Formal analysis: Jian Ye.

Methodology: Xinli Guan.

Project administration: Jian Ye.

Writing – original draft: Wei Huang.

Writing – review and editing: Wei Huang.

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