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Role of multi-detector CT venography in evaluation of pelvic congestion syndrome

Ahmad Sayed Awad[1*], Mohammed Medhat Mohammed Taha[1], Mohammed Hamam Abd Manaf[2], Mostafa Mahmoud Mohamad Gad[1] and Shady Nabil Mashhour[1]

Abstract

Background: Pelvic congestion syndrome (PCS) is a problematic cause of chronic pelvic pain in women. It is thought to result from venous insufficiency of either ovarian or pelvic veins. Patients also present a variety of symptoms including dysuria and dyspareunia as well as vulva and buttock varicosities. The aim of this study is to evaluate the efficacy of multi-detector CT (MDCT) in diagnosis of PCS. Two hundred patients were included in our study and underwent CT venography of the abdomen and pelvis.

Results: We performed a prospective comparative study conducted on 200 patients. Thirty patients (15%) were diagnosed as PCS. There were congestion of the ovarian venous plexus and uterine venous engorgement in all patients. Filling of the veins across the midline was noted in 10 patients and filling of the vulval and thigh varicosities was noted in 3 patients. Ten patients had right ovarian vein dilatation; 12 patients had left ovarian vein dilatation; while 8 patients had bilateral ovarian vein dilatation. The right ovarian vein mean diameter (± SD) = 7.1 ± 0.8 mm; while the left ovarian vein mean diameter (± SD) = 7.6 ± 1 mm. Left ovarian venous reflux was found in 6 cases while no pathological reflux depicted on right side.

Conclusions: CT venography is considered as one of the initial investigations for the diagnosis of PCS in female patients with chronic pelvic pain making the further assessment by ovarian venography is for interventional management of diagnosed cases.

Keywords: Chronic pelvic pain in females, Pelvic congestion syndrome, CT venography

Background

Chronic pelvic pain (CPP) is a common irritating symptom in females and represents a common cause of gynecologic referral [1]. Many gynecological diseases can cause CPP including endometriosis, fibroids, pelvic adhesions, uterine prolapse, and malignancies. Nongynecological causes of CPP include irritable bowel syndrome, urological, and psychiatric problems [2–4].

Pelvic congestion syndrome (PCS) is a known cause of chronic pelvic pain. It usually affects women during their childbearing and premenopausal periods. It usually results from the venous insufficiency of either ovarian or pelvic veins. The patients present by different symptoms including chronic dull aching pain lasting for more than 6 months, post-coital and premenstrual pain and heaviness, lower back pain, urinary symptoms, as well as vulvoperineal and lower extremity varicosities [2–4].

Because the etiology of pelvic vessel dilatation is probably multifactorial (e.g., hormonal and mechanical factors), PCS may occur along with other serious diseases, so imaging these vasculatures has a crucial role in screening [5].

Also sometimes, it is not clear if pelvic venous congestion is the cause of CPP and, if it does, whether it is a direct or indirect cause. Therefore, PCS represents a diagnostic as well as therapeutic problem posing a challenge for the clinician [6].

* Correspondence: ahmedawad@kasralainy.edu.eg
[1]Department of Diagnostic and Interventional Radiology, Kasr Al Ainy Faculty of Medicine, Cairo University, Cairo, Egypt
Full list of author information is available at the end of the article

Diagnosis of PCS is usually suspected by clinical examination and then confirmed by noninvasive imaging modalities including duplex ultrasound scanning, computed tomography (CT) venography, and magnetic resonance venography (MRV) [7].

Catheter-based venography can assess ovarian vein incompetence; however, this is an invasive technique and so it become more a therapeutic (selective embolization) than a diagnostic tool in the management of patients with PCS. Duplex ultrasound scanning can visualize the ovarian and pelvic veins but sometimes precise pelvic vascular anatomy is difficult to demonstrate. MRV allows noninvasive imaging with no exposure to ionizing radiation [8].

Computed tomography venography (CTV) with 3D volume rendering (VR) is relatively noninvasive and an effective procedure for evaluating abdominal, pelvic, and lower extremity vessels. It results in image quality comparable to that of conventional venography. The diagnosis of PCS can be confirmed on CT by the presence of pelvic varicosities, which appear as dilated, tubular, and contrast-enhancing structures adjacent to the adnexa, and dilated ovarian veins. Reversed flow in the ovarian vein can be suggested in the presence of ovarian vein filling on arterial phase. In addition, the CT allows diagnosis of other causes of pelvic pain, i.e., ovarian/uterine pathology [9]. It can detect morphologic changes of the left renal vein and a jetting phenomenon across the aortomesenteric portion of the left renal vein which are diagnostic criteria of nutcracker syndrome [10].

The aim of this study is to evaluate the role of multi-detector CT (MDCT) venography in the workup of the cases presented by chronic pelvic pain to detect the cause and the ability to diagnose pelvic congestion syndrome. Also, to compare the clinical and CT findings in patients with PCS and those with other causes of CPP.

Methods

This was a prospective study including 200 patients with chronic pelvic pain during the period from March 2018 to February 2019. The patients were referred to our department from the gynecology and urology departments after their clinical assessment.

Inclusion criteria

Married female patients with history of chronic pelvic pain characterized by:

- Dull pelvic ache of unclear origin
- Longer than 6 months
- Increases with menstruation

Exclusion criteria

- Patients with contraindications for contrast media injection
- History of abdomino pelvic malignancy
- History of prior hysterectomy and oophorectomy
- Patients with iliofemoral DVT

Proper clinical history including patient's age, marital history, parental history, and past history of related significance was obtained. Verbal consent was considered including procedure description and benefits. Levels of serum creatinine were measured for all patients.

Imaging procedure

There was no specific preparation for contrast-enhanced CT, except that the patient should consume nothing but clear liquids 4 h prior to the examination.

Contrast-enhanced CT was performed to all cases using the 64 detector CT scanners (Lightspeed VCT, GE Healthcare, Waukesha, WI) and (Aquilion, Toshiba Medical Systems). The parameters of the volume CT scanning were as follows: tube voltage was 120 kV; tube current was 200–250 mAs; slice thickness was 5 mm; the pitch was of 1.375 mm/r; 0.8 s was set for the tube to rotate 1 cycle; and the scan matrix was 512 × 512 matrices.

The CT scan covered the area from the renal upper pole to the pelvic floor. Both plain CT scans and enhanced CT scans (including arterial, venous, and secretory phases) were performed for all patients. Via a power injector, 80–100 mL of Omnipaque 300 mg I/ml (iohexol 300 mg I/ mL; Nycomed, Princeton, NJ) was injected intravenous (IV) at a rate of 4 mL/s as the contrast agent. CT number monitoring scanning was used for the arterial phase, followed by the venous phase scanning after an interval of 30 s. After another interval of 7–10 min, the secretory phase scanning, which covered the area from the lower pole of the 11th thoracic vertebra to the pelvic cavity, was performed. A workstation was used for the post-processing of the images, particularly the multiple planar reconstruction (MPR), volume rending (VR), and curved plane reconstruction (CPR) of the venous phase images.

Imagine analysis

All scans were downloaded from DICOM server to workstation, and two radiologists experienced on abdominopelvic radiology examined the images.

Images during arterial phase were used to rule out possible reflux into ovarian veins, and images from venous phase were used for the assessment of pelvic and ovarian veins as well as identifying drainage locations of ovarian veins to renal vein or IVC. Also, the venous

phase was used for assessment of abdominal and pelvic organs. The plain and secretory CT phases were used for assessment of the urinary system to exclude urological causes of the pain.

First, the CT images were assessed for presence of organic masses, enlarged lymph nodes, or any lesions which may be the cause of the chronic pelvic pain or causing vascular obstruction and secondary PCS.

The assessment of ovarian veins included their diameters and drainage location to renal vein or IVC. Maximum diameters of both ovarian veins were measured in the axial plane. The widest diameters of ovarian veins from two-fold magnified images on monitor using measuring tool were registered. After observing axial sections by scrolling images for tracking the course of ovarian veins, the drainage location of ovarian veins also was noted.

The diagnosis of pelvic congestion syndrome was based on presence of dilated ovarian veins (more than 5.5 mm) and para uterine venous plexus congestion (dilated veins more than 0.5 cm, tortuous, and difficult to see separately). Filling of the veins across the midline, vulval, and thigh varicosities was also recorded.

Statistical analysis

Data entry, processing, and statistical analysis was carried out using MedCalc version 15.8 (MedCalc, Ostend, Belgium). Tests of significance (Mann-Whitney's, Chi square, logistic and multiple regression analysis, Spearman's correlation, and ROC Curve analysis) were used. Data were presented and suitable analysis was done according to the type of data (parametric and non-parametric) obtained for each variable. *P* values less than 0.05 (5%) was considered to be statistically significant.

Results

This is a prospective comparative study conducted on 200 patients with chronic pelvic pain; to assess the role of MDCT venography in evaluation of pelvic congestion syndrome. The age of all patients ranged from 29 to 44 years.

We considered ovarian vein dilatation more than 5.5 mm and presence of para uterine venous plexus congestion and pelvic varices as criteria for diagnosis of PCS. There criteria were found in 30 patients. So the 200 CPP patients were classified according to presence of PCS into 2 independent groups; normal (no PCS) group (170 patients) and PCS group (30 patients).

Regarding the CT findings, 108 patients (54%) showed no gross CT abnormalities. Thirty patients (15%) had PCS, 28 patients (14%) had simple ovarian cyst, 3 patients (1.5%) had complex ovarian cyst, and 32 patients (16%) had fibroid.

In the PCS patients, no abdominopelvic masses or mechanical causes of pelvic congestion were depicted. In addition to the chronic pelvic pain, 14 patients gave history of dyspareunia and 2 patients gave history of dysuria.

In PCS patients, there were congestion of the ovarian venous plexus and uterine venous engorgement in all patients (Figs. 1, 2, and 3). Filling of the veins across the midline was noted in 10 patients and filling of the vulval and thigh varicosities was noted in 3 patients. Ten patients (33.3%) had right ovarian vein dilatation, 12 patients (40%) had left ovarian vein dilatation, while 8 patients (26.7%) had bilateral ovarian vein dilatation.

Regarding ovarian vein diameter in PCS, the right ovarian vein diameter ranged from 5.4 to 8.6 mm with mean diameter (± SD) = 7.1 ± 0.8 mm while the left ovarian vein diameter ranged from 5.7 to 8.8 mm with mean diameter (± SD) = 7.6 ± 1 mm. Regarding ovarian vein competence, left ovarian vein elicited venous reflux in 6 cases while no pathological reflux depicted on the right side.

In non PCS patients, the right ovarian diameter ranged from 2.8 to 3.3 mm with mean value of 3 mm while the left ovarian diameter ranged from 2.7 to 3.4 mm with mean value of 3.1 mm. Comparative study between the 2 groups revealed highly significant increase in the right and left ovarian veins diameter in PCS group, compared with normal group, with highly significant statistical difference ($p < 0.01$) (Table 1).

A retroaortic left renal vein (RLRV) was present in 4 cases, and 2 cases had a circumaortic left renal vein variation. No related renal vein stenosis or occlusion depicted. No cases of nutcracker syndrome depicted in current study. No IVC anomalies depicted in the current study.

Comparative study between the 2 groups revealed that the incidence of PCS increases with age during childbearing period and more in multiparous women.

Comparative study between the 2 groups revealed non-significant difference as regards previous operations, number of C-sections, and number of D and Cs ($p > 0.05$) (Table 2).

Comparative study between the 2 groups revealed highly significant increase in menstrual and coital-related symptoms in PCS group, compared with normal group, with highly significant statistical difference ($p < 0.0001$) (Table 3).

Discussion

Chronic pelvic pain in females is defined as pain originating in the lower abdomen or pelvis for more than 6 months, which is not exclusively cyclical or intercourse-related and not usually relieved by analgesics. It accounts for 10–40% of all gynecologic referrals [1].

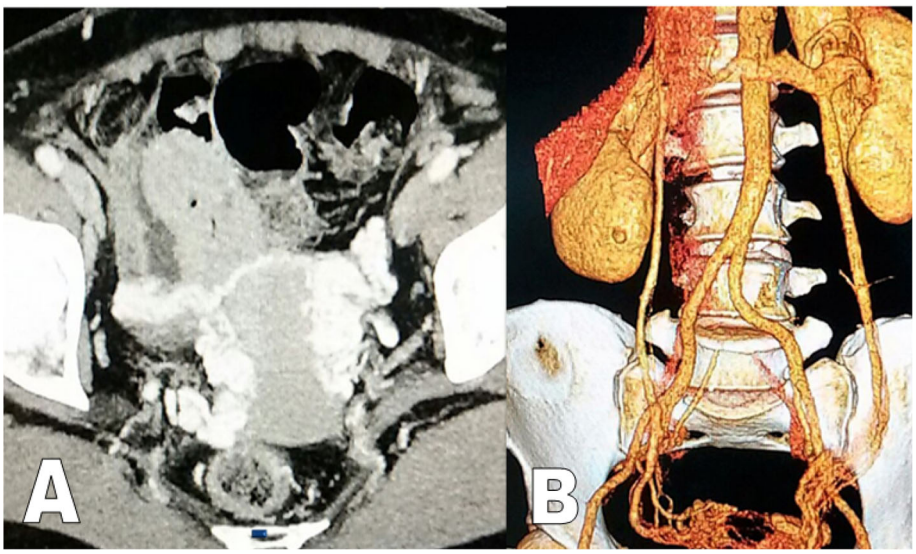

Fig. 1 **a** Axial CTV of the pelvis showing multiple dilated and congested parametric and ovarian veins. **b** 3D VR CTV of the abdomen and pelvis showing dilated both ovarian veins along their courses

PCS is one of the common causes of chronic pelvic pain. It affects mainly the multiparous women, and usually presented during the childbearing period [2, 3]. This was confirmed in our study, as the patients' ages ranged from 32 to 44 years, and most of them were multiparous.

PCS is said to occur as a result of retrograde flow in an incompetent ovarian vein. Ovarian vein incompetence is seen in approximately 10% of women and up to 60% with this abnormality can develop PCS [7].

The diagnosis of PCS continues to challenge all physicians. Imaging is vital in the diagnosis of PCS and is used to confirm the clinical suspicion of this condition. Noninvasive investigations are recommended as an initial assessment [3].

Our study was a prospective study conducted on 200 patients with chronic pelvic pain; to evaluate the role of MDCT venography in evaluation of pelvic congestion syndrome.

All chronic pelvic pain (CPP) patients were then classified according to the presence of PCS into 2 independent groups, normal (no PCS) group and pelvic congestion syndrome (PCS) group. We found that (15%) of examined patients had PCS, (14%) had simple ovarian cyst, (1.5%) had complex ovarian cyst, (16%) had fibroid, and 108 patients (54%) showed no gross CT

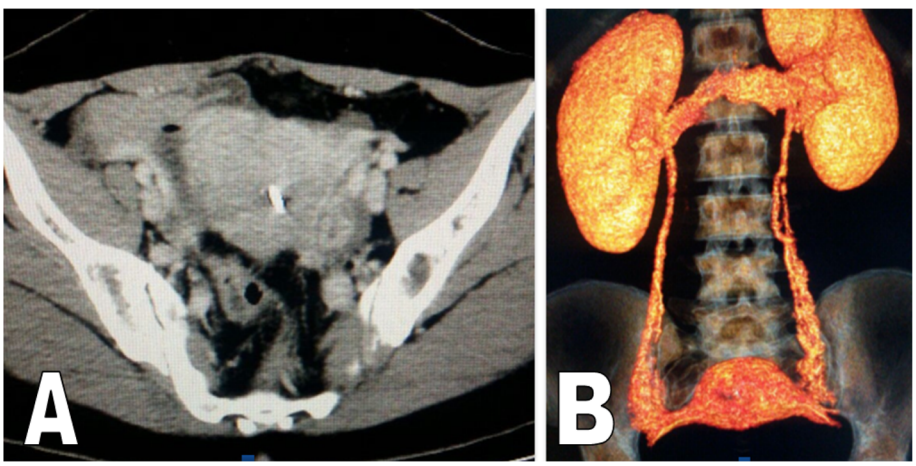

Fig. 2 **a** Axial CTV of the pelvis showing multiple dilated and congested parametric and ovarian veins. **b** 3D VR CTV of the abdomen and pelvis showing dilated both ovarian veins along their courses

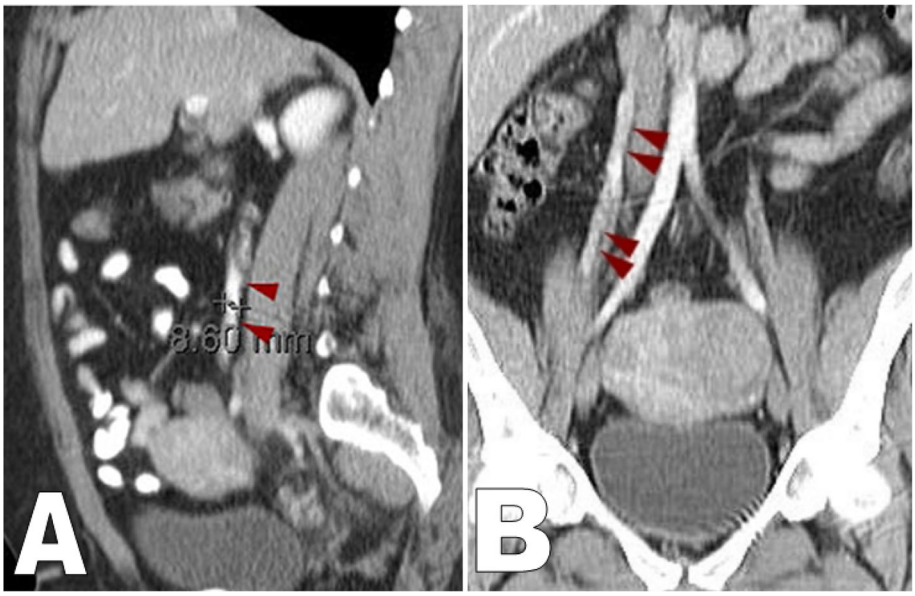

Fig. 3 **a**, **b** Sagittal and coronal MPR CTV showing dilated right ovarian vein and mildly congested pelvic veins

abnormalities. This incidence of PCS was reported to be 31% among symptomatic women by Soysal ME et al. 2002 [11].

Regarding CT venography data, comparative study between the 2 groups revealed highly significant increase in right, left, and average ovarian diameter in PCS group compared with normal group, with highly significant statistical difference ($p < 0.01$). This is an essential part of the diagnostic criteria of PCS and match with that reviewed by Phillips D et al. 2014 [12].

We found that of all PCS patients, 33.3% of patients had right ovarian vein dilatation, 40% of patients had left ovarian vein dilatation, while 26.7% of patients had bilateral ovarian vein dilatation. Similar findings of higher incidence of dilatation in the left ovarian vein were reported by Heinz A and Brenner E 2010 [13]. Szaflarski D et al. found that higher incidence of dilatation was bilateral followed by left ovarian vein only [14].

In our study, in PCS group, the right ovarian vein diameter ranged from 5.4 to 8.6 mm with mean diameter (± SD) = 7.1 ± 0.8 mm while the left ovarian vein diameter ranged from 5.7 to 8.8 mm with mean diameter (± SD) = 7.6 mm ± 1. There results match with the study of Szaflarski et al., which was conducted on a large number of patients (1042) using the CT for assessment of the degree of the ovarian vein dilatation that was present in 143 patients. They considered the diameter parameter as a criterion for diagnosis of the PCS with the mean diameter for the dilated left ovarian vein = 7.5 mm while for the right ovarian vein = 7.2 mm. Also, they suggest utilizing an ovarian vein dilatation grading scheme of mild (5–6 mm), moderate (6–8 mm), and severe (> 8 mm) [14]. Park S et al. consider ovarian vein diameter cutoffs starting above 4 mm as diseased veins [3].

Comparative study between the 2 groups revealed highly significant increase in age, gravida, and parity in PCS group compared with normal group. These results confirm the predisposing factors of PCS and similar to that reviewed by Borghi C and Dell'Atti L 2016 [15]. The higher incidence of PCS in multiparous women likely related to increased pelvic vein capacity during pregnancy, which can result in valve incompetence and retrograde blood flow. This change may persist for 6 months after pregnancy [15].

There was highly significant increase in menstrual and coital-related symptoms in PCS group compared with normal group. These results are similar to that reviewed by Jung SC et al. 2009 [16].

Table 1 Comparison between the 2 groups as regards ovarian vein data using Mann-Whitney's *U* test

Variable	Normal group (170)	PCS group (30)	Mann-Whitney *U* test
	Mean	Mean	*P* value
Right ovarian vein diameter (mm)	3	7.1	< 0.0001
Left ovarian vein diameter (mm)	3.1	7.6	< 0.0001

Table 2 Comparison between the 2 groups as regards surgical history using Chi-square test

Variable		Normal group (170)	PCS group (30)	Chi-square test *P* value
Previous operations	No	88 (51.8%)	14 (46.7%)	= 0.751
	Yes	82 (48.2%)	16 (53.3%)	
Number of C-sections	No operation	91 (53.5%)	14 (46.7%)	= 0.439
	1 operation	25 (14.7%)	4 (13.3%)	
	2 operation	33 (19.4%)	8 (26.7%)	
	3 operation	18 (10.6%)	3 (10%)	
	4 operation	3 (1.8%)	1 (3.3%)	
Number of D&Cs	No operation	155 (91.2%)	25 (83.3%)	= 0.264
	1 operation	11 (6.5%)	4 (13.3%)	
	2 operation	4 (2.4%)	1 (3.3%)	

Our study confirmed the role of CT venography in diagnosis of pelvic congestion syndrome, assessment of the ovarian vein diameter as included in previous studies. So it can guide the clinician for further assessment with or without intervention according to individual findings of each case. Kies D and Kim H in 2012 stated that CT Venography is highly effective in identifying pelvic and lower extremity vessels and ovarian varices with image quality comparable to that of conventional venography. Also, it can demonstrate the pelvic or abdominal causes of venous dilatation [9].

Conclusion

CT venography is relatively noninvasive and an effective procedure for evaluating abdominal and pelvic vessels. It assesses the ovarian vein diameter, para metric venous congestion, and the presence of vulvoperineal and thigh varicosities. Also, it is useful in the assessment of outflow for the pelvic venous drainage through left renal and iliac veins. So CT venography is a well-suited screening method in the initial evaluation of patients with chronic pelvic pain to detect the cause with the ability to diagnose pelvic congestion syndrome and so it can guide the clinician for further management.

Table 3 Comparison between the 2 groups as regards CPP-related symptoms

Variable		Normal group (170)	PCS group (30)	Chi-square test *P* value
CPP related symptoms	Menstruation related	46 (27.1%)	11 (36.7%)	< 0.0001
	Coital related	5 (2.9%)	6 (20%)	
	Both	6 (3.5%)	7 (23.3%)	
	No related symptom	113 (66.5%)	6 (20%)	

Abbreviations

CPP: Chronic pelvic pain; PCS: Pelvic congestion syndrome; CTV: Computed tomography venography; CPR: Curved planner reconstruction; VR: Volume rendering; MDCT: Multi-detector CT; D&C: Dilatation and curettage; IV: Intravenous; KV: Kilovolt; mAs: Milliamperes; MIP: Maximum intensity projection; ml: Milliliter; MRP: Multi planner reconstruction

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Authors' contributions

AS formulated the research goals, designed the study methodology, and supervised/actively participated in the research activity planning/execution. MT conducted/actively participated in the research process, performed the data collection/data analysis, and wrote the initial draft of the manuscript. MH shared in study conception, design and shared in writing, and correcting the manuscript and revision. MG actively participated in research activity execution, assisted in data analysis, and largely contributed in reviewing and writing of the manuscript. SM assisted in data analysis and largely contributed in reviewing the manuscript. Also, he contributed in follow up of the patients. All authors have read and approved the manuscript.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

This study was approved by the Research Ethics Committee of the Faculty of Medicine, Cairo University on February 2018. Ethics Committee reference number is not available (was not provided). Written informed consent was obtained from all the study patients before any data or scans were gathered or performed.

Consent for publication

All patients included in this research gave verbal consent to publish the data contained within this study.

Competing interests

The authors declare that they have no competing interests.

Author details

[1]Department of Diagnostic and Interventional Radiology, Kasr Al Ainy Faculty of Medicine, Cairo University, Cairo, Egypt. [2]Department of Obstetrics and Gynecology, Kasr Al Ainy Faculty of Medicine, Cairo University, Cairo, Egypt.

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