

可视红光透照检查各类乳腺的影像学特点及临床决策的研究

赵莹¹,李静²,陶苹³,乔友林²,黄源¹,李佳圆¹,王可非⁴,李勇⁴

(1.四川大学华西公共卫生学院,四川成都610041;2.中国医学科学院肿瘤医院/肿瘤医院,北京100021;

3.四川省第二人民医院(四川省肿瘤医院),四川成都610041;4.伊籁麦吉科技有限公司,北京100085)

摘要: [目的] 获得各类乳腺的乳腺透照检查(TBS)的影像学特征,制定TBS筛查乳腺疾病的临床决策标准。[方法] 以钼靶X线或病理检查结果为金标准,收集乳腺癌、纤维腺瘤、乳腺囊肿、乳腺良性增生、乳腺炎和正常乳腺的TBS结果。从乳腺透照的肿块影、血管影、整体透光性和密度均匀度等方面对TBS成像特点构成进行描述,经专家小组讨论,确定TBS的临床决策标准。[结果] 共收集111人(222例单侧乳腺)的影像学资料,TBS的阳性影像特征为肿块影或暗区,血管纹理异常或未见异常,否则为阴性。乳腺癌(20例)进一步检查推荐率为95.0%。[结论] TBS能够区分病变乳腺与正常乳腺,但TBS进行乳腺疾病初筛的准确性还需要进一步评估。

关键词: 乳腺透照检查;可视红光;乳腺筛查;临床决策

中图分类号: R737.9 **文献标识码:** A **文章编号:** 1004-0242(2013)06-0506-06

Imaging Features and Clinical Decisions for Various Breast Diseases Using Transillumination Breast Screening with Visible Red Light

ZHAO Ying¹, LI Jing², TAO Ping³, et al.

(1. West China School of Public Health, Sichuan University, Chengdu 610041, China; 2. Cancer Institute/Hospital, Chinese Academy of Medical Sciences, Beijing 100021, China; 3. The Second People's Hospital of Sichuan, Chengdu 610041, China; 4. Elemage Technology Co. Ltd, Beijing 100085, China.)

Abstract: [Purpose] To determine a clinical decision criteria of primary breast screening based on the image features of transillumination breast screening (TBS) with visible red light. [Methods] The image features of various breast diseases including breast cancer, fibroadenoma, cysts, hyperplasia, mastitis and normal breasts were recorded using TBS with visible red light. Regarding mammography and/or pathology diagnosis as the gold standards, the shadow of lump, blood vessel, overall transmittance and density homogeneity of breast diseases were described in details. Image records were evaluated and studied through experts' review to define the clinical decision criteria for TBS. [Results] Image features of visible red light in 111 cases (222 unilateral breasts) was recorded in this study. Visible grey or dark areas with normal or abnormal vascular shadow were defined as TBS positive. The further examination recommended rate for breast cancer in this study was 95.0% (20 cases with breast cancer). [Conclusions] TBS can differentiate breast diseases especially breast cancer from the normal breast. Further studies on accuracy of TBS in primary breast screening are necessary.

Key words: transillumination breast screening; visible red light; breast screening, clinical decision

乳腺疾病是妇女中的常见病,其中乳腺癌是女性中发病率最高的恶性肿瘤之一,发病年龄呈逐渐年轻化趋势,严重威胁着我国妇女的健康^[1]。目前认为筛查是及早发现疾病、降低乳腺癌死亡率的有效手段^[2,3]。可视红光(550~650nm)可被血红蛋白吸收,

病变组织中血管分布密集,影像表现为灰度增加,颜色越深提示恶性可能性越大。近年来,随着发光二极管技术的发展,设备逐渐小型化,设计成为一种手持式的乳腺透照仪,且便携、经济、安全,在经济欠发达国家或地区,或可成为一种基层医疗机构筛查乳腺癌的辅助检查手段。在应用之前,需对乳腺透照检查(transillumination breast screening, TBS)的灵敏度、特

收稿日期:2012-11-27;修回日期:2013-01-14

通讯作者:李佳圆, E-mail: lijiaoyuan73@163.com

异性和预测值进行评估,但目前尚无统一的 TBS 影像学判定标准。本研究通过对已明确诊断的良、恶性乳腺疾病及正常的女性进行 TBS 复查,确定各类乳腺 TBS 的影像学特征和临床决策标准,以指导进一步评估试验的开展。

1 资料与方法

1.1 研究对象

研究对象为 2011 年 3 月至 5 月四川省肿瘤医院乳腺科门诊及住院部的女性。纳入标准:①未进行乳腺或肿块切除;②已有明确的影像学或病理学诊断结果;③意识清晰,能回答检查过程中调查员的问卷提问。最终共 111 人进行 TBS 影像学检查,包括 20 例乳腺癌,24 例纤维瘤,20 例乳腺囊肿,24 例乳腺良性增生患者和 20 名乳腺正常者,试验过程中发现乳腺炎的 TBS 影像与乳腺癌易混淆,另纳入 3 例乳腺炎患者。

1.2 检查仪器

使用 ELEMAGE™ 便携式乳腺透照检查仪进行 TBS 检查。工作原理:仪器发射的无害可视红光($625\pm 10\text{nm}$)可被血红蛋白吸收,病变组织中血管分布密集,影像表现为灰度增加,颜色越深提示恶性可能性越大。

1.3 检查方法

在暗室中,受检者裸露上身,面对检查者坐或立,身体略前倾,胸部放松。检查者手持乳腺透照仪,探头紧贴乳房皮肤,将乳房托起,使整个乳房透亮起来。仔细观察双乳是否有肿块影,及其数量、大小、形态、灰阶度、部位和与血管影的关系。根据观察的需要,可调节光源强度,按乳晕、乳房内侧、乳房外侧及腋窝四个部位顺序观察。在移动时,探头始终要贴近乳房皮肤。

1.4 资料整理与分析

采用 Excel 2007 录入 TBS 问卷内容和检查结果,建立数据库;应用 SPSS18.0 软件对乳腺透光性、密度均匀度、肿块影、血管影及两者之间关系的 TBS 成像特点进行频数描述;通过定性研究中的专题小组讨论,归纳总结各类乳腺 TBS 检查的影像学特征及临床决策标准。

2 结果

2.1 不同乳腺状态的 TBS 成像结果比较

本研究共检查 111 人,即 222 例单侧乳腺,包括 20 例乳腺癌,27 例纤维腺瘤,33 例囊肿,43 例良性增生,96 例正常乳腺和 3 例乳腺炎。根据乳腺的整体透光性、肿块影、血管影及二者间关系等方面对其 TBS 成像进行描述 (Table 1)。对 TBS 观察到的 46 个肿块影的大小、形状、灰阶度、边缘清晰度四个方面进行描述 (Table 2)。

①乳腺癌:17 例乳腺癌肿块直径大于 1cm。TBS 观察到全部 17 例肿块影,其中 13 例 (76.5%) 乳腺血管纹理增粗、紊乱,向肿块影伸入、集中,或血管包绕肿块影,或血管在病灶区突然中断,推动包块可见血管随肿块影同步移位。肿块直径小于 1cm 的 3 例乳腺癌中,2 例未见明显肿块影,3 例均未能观察到异常的血管影。

②乳腺良性肿瘤:直径大于 1cm 的乳腺纤维瘤和囊肿,经 TBS 透照后呈现多种类型团块影,病变区域血管与团块影无明显关系;直径小于 1cm 的乳腺纤维瘤和囊肿,大多乳腺透光性良好且密度均匀,未见肿块影或异常血管影。

③乳腺良性增生:7 例重度增生中,4 例 (57.1%) 乳腺的整体透光度减低,TBS 影像呈絮状或云片状表现,3 例 (42.9%) 乳腺可见边缘不清晰的团块影,其中 1 例周围血管纹理增多、扩张,并向肿块影伸入、集中;轻度乳腺良性增生 TBS 影像多未见异常。

④乳腺炎症:3 例乳腺炎症透照后均能观察到明显的肿块影,形状不规则,颜色较深,边缘模糊,同时伴有血管纹理增多增粗,向肿块影延伸、集中或包绕,难与乳腺癌的影像鉴别。

⑤正常乳腺:96 例正常乳腺中,82 例 (85.4%) 透光度良好,均匀,清晰,无暗区,血管行走自如;14 例 (14.6%) 透光性稍差,但密度均匀,无暗区,无异常血管影。

2.2 各类乳腺 TBS 的典型影像学特征

通过对 222 例单侧乳腺的 TBS 成像特点进行整理分析,归纳各类乳腺 TBS 的影像学特征 (Table 3)。

2.3 乳腺透照仪的临床决策

根据不同乳腺良、恶性病变的 TBS 影像学特点,制定可视红光乳腺透照检查的临床决策标准 (Table 4)。

Table 1 The imaging characteristics of various breast diseases [n(%)]

Breast diseases ^a	N	Transmittance			Density homogeneity		Shadow of lump		Vascular shadow ^c				Relationships between lump and blood vessel	
		Overall	Overall but weak ^b	Partial	Homogeneous	Inhomogeneous	No	Yes	A	B	C	Obvious ^d	No	No
Breast cancer														
Lump size <1cm	3	1(33.3)	1(33.3)	1(33.3)	1(33.3)	2(66.7)	2(66.7)	1(33.3)	2(66.7)	1(33.3)	0	0	1(100.0)	
Lump size ≥1cm	17	0	0	17(100.0)	0	17(100.0)	0	17(100.0)	4(23.5)	0	13(76.5)	13(76.5)	4(23.5)	
Fibroadenoma														
Lump size <1cm	9	8(88.9)	0	1(11.1)	8(88.9)	1(11.1)	8(88.9)	1(11.1)	9(100.0)	0	0	0	1(100.0)	
Lump size ≥1cm	18	2(11.1)	2(11.1)	14(77.8)	4(22.2)	14(77.8)	4(22.2)	14(77.8)	14(77.8)	3(16.7)	1(5.5)	1(7.1)	13(92.9)	
Cysts														
Lump size <1cm	24	21(87.5)	3(12.5)	0	17(70.8)	7(29.2)	24(100.0)	0	21(87.5)	3(12.5)	0	—	—	
Lump size ≥1cm	9	3(33.3)	0	6(66.7)	2(22.2)	7(77.8)	2(22.2)	7(77.8)	3(33.3)	4(44.5)	2(22.2)	2(28.6)	5(71.4)	
Hyperplasia														
Mild	36	36(100.0)	0	0	36(100.0)	0	36(100.0)	0	30(83.3)	6(16.7)	0	—	—	
Severe	7	0	4(57.1)	3(42.9)	0	7(100.0)	4(57.1)	3(42.9)	3(42.9)	3(42.9)	1(14.2)	1(33.3)	2(66.7)	
Normal														
Age<35 years	36	28(77.8)	8(22.2)	0	36(100.0)	0	36(100.0)	0	30(83.3)	6(16.7)	0	—	—	
Age≥35 years	60	54(90.0)	6(10.0)	0	60(100.0)	0	60(100.0)	0	50(83.3)	10(16.7)	0	—	—	
Mastitis														
	3	0	0(0.0)	3(100.0)	0(0.0)	3(100.0)	0(0.0)	3(100.0)	0(0.0)	0(0.0)	3(100.0)	3(100.0)	0	0

Notes: ^a Lump size was divided on result of mammography or ultrasonography, the degree of hyperplasia was judged by CBE or mammography; ^b Compared to the contralateral breast, the transmittance of affected side was weaker, but without dark areas; ^c A: A small amount of thin vascular shadows; B: Thicker vascular shadows appeared reticular distribution around the areola; C: The vascular shadows were obvious with thickening or twisting, including drainage, radial, branch and peripheral 4 types; ^d The relationships of lump and blood vessel included 3 major types: ① lump distributing around vessels, ② drainage vessels appearing in lesions areas, ③ drainage vessels appearing in the perilesional areas, which were most common in breast cancer.

Table 2 Imaging characteristics of shadows of lump [n(%)]

Breast diseases	N	Size(cm)					Shape			Grey scale			Edge	
		<1	1~2	2~5	>5	>5	Circular	Oval	Irregular	Light grey	Grey	Dark grey	Clear	Unclear
Breast cancer	18	0	5(27.8)	11(61.1)	2(11.1)	2(11.1)	2(11.1)	3(16.7)	13(72.2)	0	5(27.8)	13 (72.2)	0	18(100.0)
Fibroadenoma	15	1(6.7)	8(53.3)	6(40.0)	0	6(40.0)	6(40.0)	3(20.0)	6(40.0)	0	11(73.3)	4(26.7)	8(53.3)	7(46.7)
Cysts	7	0	4(57.1)	2(28.6)	1(14.3)	3(42.9)	3(42.9)	1(14.3)	3(42.9)	1(14.3)	3(42.9)	3(42.9)	4(57.1)	3(42.9)
Hyperplasia	3	0	2(66.7)	1(33.3)	0	2(66.7)	1(33.3)	1(33.3)	0	0	2(66.7)	1(33.3)	0	3(100.0)
Mastitis	3	0	1(33.3)	2(66.7)	0	0	0	2(66.7)	1(33.3)	0	0	3(100.0)	0	3(100.0)

2.4 乳腺透照仪临床决策标准的预评价

乳腺癌和乳腺炎症患者进一步检查推荐率(简称“推荐率”)达 95%及以上,直径 $\geq 1\text{cm}$ 的纤维瘤和囊肿及重度乳腺良性增生的推荐率达 75%以上(Table 5)。

3 讨 论

由于组织中的含铁血黄素、血红蛋白等对红光的吸收较为敏感,利用红光透照乳腺组织时,病变区域血流丰富,与正常组织的吸收差异,显示出不同的

TBS 影像特点。不同于既往所使用的近红外乳腺投射成像诊断^[4,5],TBS 成像通过肉眼可直接观察到乳腺病变组织和血管影像。本研究对所观察到的不同病理类型的 TBS 影像特点进行分析,正常乳腺透照无暗区或肿块影,血管分布均匀,走行自然;而发生癌变的组织,很容易在透照影像中显示组织灰度增加和异常血管成像。由于能够清晰地显示组织的透光程度,肿块影的大小、灰度、边缘,以及血管影与肿块影的关系等,TBS 对发现病变乳腺以及初步鉴别良、恶性乳腺疾病提供较为准确的客观影像。在预评

Table 3 TBS imaging characteristics of various breast diseases

Breast diseases	The imaging characteristics of TBS				
	Transmittance	Density homogeneity	Shadow of lump	Vascular shadow ^a	Relationship between lump and blood vessel
Breast cancer	Partial	Inhomogeneous	Irregular shape, unclear edge, dark in central and light at edge	C	Lump distributing around blood vessel / Drainage vessel appearing in lesions or perilesional areas
Fibroadenoma	Partial	Inhomogeneous	Regular shape, clear edge	A/B	No relationship
Cysts	Enhanced (The cystic fluid is clear liquid) / Partial	Inhomogeneous	Difficult detection, unclear edge	A/B	No relationship
Hyperplasia	Overall but weak / Partial	Flocculent or flaky high-density image	None	A/B	—
Mastitis	Partial	Inhomogeneous	Irregular shape, unclear edge, dark in whole lesions	B/C	Lump distributing around blood vessel / Drainage vessel appearing in lesions or perilesional areas
Normal	Overall	Homogeneous	None	A	—

Notes: ^a A: A small amount of thin vascular shadow; B: Thicker vascular shadow appeared reticular distribution around the areola; C: The vascular shadow was obvious with thickening or twisting, including drainage, radial, branch and peripheral 4 types.

Table 4 Clinical decisions criteria for TBS

Result of TBS		Judging index ^a				Suspected diseases	Recommended further examination
		Inconsistent transmittance ^b	Lump shadow or dark area	Vascular texture thickening, disordering, twisting, pulling into a corner	Blood vessels stretching into lesion		
Positive	Suspicious of malignancy	√	√	√	√	①Breast cancer ②Mastitis	Mammography/ Ultrasonography/ Pathology
	Benign lump	√	√	—	—	①Fibroadenoma($\geq 1\text{cm}$) ②Cysts ($\geq 1\text{cm}$) ③Severe hyperplasia	Mammography/ Ultrasonography
Negative	Suspicious of benign	√	—	—	—	①Fibroadenoma($<1\text{cm}$) ②Cysts($<1\text{cm}$) ③Mild hyperplasia	Mammography/ Ultrasonography
	Normal	—	—	—	—	①Normal ②Other mild benign lesions	Follow-up

Note: ^a “√” represented that the breast had the kind of characteristics by TBS. ^b Flocculent/flaky high-density image or thickening vascular shadow was detected from unilateral breast.

Table 5 Pre-evaluation for clinical decisions criteria of TBS

Breast diseases ^a		N	Clinical decisions from TBS result				Further examination recommended rate ^b (%)
			Suspicious of malignancy	Benign lump	Suspicious of benign	Normal	
Breast cancer	—	20	13	5	1	1	95.0
Fibroadenoma	Lump size <1cm	9	0	1	0	8	11.1
	Lump size ≥1cm	18	1	13	2	2	88.9
Cysts	Lump size <1cm	24	0	0	3	21	12.5
	Lump size ≥1cm	9	2	5	0	2	77.8
Hyperplasia	Mild	36	0	0	0	36	0.0
	Severe	7	1	2	4	0	100.0
Mastitis	—	3	3	0	0	0	100.0
Normal	—	96	0	0	14	82	14.6
Total		222	20	26	24	152	31.5

Notes: ^a Lump size was divided by result of mammography or ultrasonography, the degree of hyperplasia was judged by CBE or mammography;

^b Further examination recommended rate= (Suspicious of malignancy+ Benign lump+ Suspicious of benign)/Total number.

价研究中,初步评定乳腺癌病例进一步诊断推荐率达95%,肿块直径≥1cm的纤维瘤和囊肿及重度乳腺良性增生的推荐率达75%以上;正常乳腺的推荐率仅为14.6%,且透照未见暗区或肿块影,多为致密腺体型乳房或小乳房。提示依据本研究所制定的临床决策标准,可视红光的乳腺透照检查能够较好地地区别病变乳腺和正常乳腺。

乳腺疾病病变程度不同,TBS发现病变组织的能力也有较大的差别。肿块直径<1cm的纤维瘤和囊肿的进一步检查推荐率分别只有11.1%和12.5%,说明早期乳腺疾病TBS不易发现,可能的原因有:①对于早期病变组织较小,如小的纤维瘤或囊肿,TBS不易显影;②TBS对于萎缩型小乳腺,或位于乳腺基底部、贴近胸壁的病变,检查较为困难;③TBS对检查技术和经验的依赖性较强,仪器操作的准确性会直接影响检查结果。因此在检查时,可先通过详细扪诊,对可能的病变位置进行定位,再行TBS检查。仪器的探头紧贴皮肤,可适当调节光源强度观察双乳透光性、是否有团块影,与血管影的关系。光源亮度过强,容易遗漏病变阴影;在亮度调节适合的情况下,如果观察部位效果仍然不清晰,可将乳房轻压向探头方向。

此外,本研究发现乳腺炎的TBS影像学特征酷似乳腺癌,易混淆。在孕期、哺乳期及月经前期由于受到内分泌的影响乳房呈现充血状态^[6],血管影可能会增粗、增多,纹理较为紊乱,影响TBS结果的准确性。

面对乳腺癌发病和死亡的严峻形势,世界各国特别是欧美发达国家提出了不同的乳腺癌筛查推荐方案,而目前我国尚无一套成熟的符合中国女性的生理特点和中国国情的乳腺癌筛查方案^[7,8]。在我国为期三年的全国乳腺癌筛查项目中,采用乳腺临床扪诊(CBE)初筛→钼靶X线诊断→超声检查的串联筛查方案,但筛查效果受扪诊初筛准确性影响较大,有效性尚不能肯定。国外的研究也报道^[9],根据成本效益分析CBE筛查乳腺癌适用于经济不发达的发展中国家,但其结果和诊断准确性依赖于医生的技术和经验。本研究发现,TBS能够提供客观的影像信息,较好地区别病变组织和正常组织,将乳腺临床扪诊和TBS结合运用于乳腺癌筛查的第一步,或可提高初筛的灵敏度和准确性,为制定进一步的乳腺癌诊疗方案提供参考。相对于钼靶X线、超声检查^[8,10],TBS具有经济、简便易行,对受检者无射线或侵入性伤害,可反复检查等优点,尤其是近年来,近红外透视设备的小型化,使得该方法可在经济欠发达国家或地区以及医疗卫生资源缺乏的基层医疗机构在开展乳腺癌筛查中推广使用,避免资源浪费、过度诊断给患者和社会带来经济负担。在将TBS大规模运用于人群应用前,根据本研究制定的TBS的影像学特征和临床决策标准,还需要开展平行盲法的人群评价试验对其准确性进行评估。

参考文献:

- [1] Huang ZZ, Chen WQ, Wu CX, et al. Incidence and mor-

- ality of female breast cancer in China — a report from 32 Chinese cancer registries, 2003–2007 [J]. *Cancer*, 2012, 32(6):435–439. [黄哲宙, 陈万青, 吴春晓, 等. 中国女性乳腺癌的发病和死亡现况——全国 32 个肿瘤登记点 2003–2007 年资料分析报告 [J]. *肿瘤*, 2012, 32(6):435–439.]
- [2] Nelson HD, Tyne K, Naik A, et al. Screening for breast cancer: systematic evidence review update for the U. S. preventive services task force [J]. *Ann Intern Med*, 2009, 151(10):727–742.
- [3] Dong ZW. The guidelines of cancer screening, early diagnosis and treatment in China [M]. Beijing: Peking University Medical Press, 2005. 22–33. [董志伟. 中国癌症筛查及早诊早治指南 (试行) [M]. 北京: 北京大学医学出版社, 2005. 22–33.]
- [4] Wang HL, Zhao ZH, Wu YF. The application of near infrared light in breast diseases examination [J]. *Modern Journal of Integrated Traditional Chinese and Western Medicine*, 2010, 19(10):1264. [王会玲, 赵志宏, 吴玉芳. 红外线乳腺诊断仪在乳腺疾病检查中的应用价值 [J]. *现代中西医结合杂志*, 2010, 19(10):1264.]
- [5] Song FJ, Jia ZY. The physical principles of near infrared breast diaphanography and early diagnosis of breast cancer [J]. *Physics*, 2009, 38(1):33–40. [宋菲君, 贾卓颖. 近红外影像诊断的物理基础和乳腺癌的早期诊断 [J]. *物理*, 2009, 38(1):33–40.]
- [6] Li CY. The clinical application of near infrared light diagnosis in breast disease screening [J]. *Guide of China Medicine*, 2010, 8(23):123–124. [李翠英. 近红外光乳腺诊断仪在乳腺疾病筛查中的临床应用 [J]. *中国医药指南*, 2010, 8(23):123–124.]
- [7] Dai HJ, Zhu XL, Li HX, et al. Technologic progress in screening, early detection and treatment for breast cancer [J]. *China Cancer*, 2009, 18(9):713–716. [戴弘季, 朱晓灵, 李海欣, 等. 乳腺癌筛查及早诊早治技术的研究进展 [J]. *中国肿瘤*, 2009, 18(9):713–716.]
- [8] Mo M, Liu GY, Lv LL, et al. Advances in breast cancer screening program [J]. *Cancer*, 2012, 32(9):748–754. [莫森, 柳光宇, 吕力琅, 等. 乳腺癌筛查研究进展 [J]. *肿瘤*, 2012, 32(9):748–754.]
- [9] Okonkwo QL, Draisma G, der Kinderen A, et al. Breast cancer screening policies in developing countries: a cost-effectiveness analysis for India [J]. *J Natl Cancer Inst*, 2008, 100(18): 1290–1300.
- [10] Ji YJ, Chang C, Ding JH, et al. The value of breast ultrasound in a mammography based Chinese breast screening project [J]. *Journal of Surgery Concepts & Practice*, 2010, 15(5):486–489. [季亚婕, 常才, 丁建辉, 等. 中国乳腺 X 线筛查项目中联合应用超声检查的价值 [J]. *外科理论与实践*, 2010, 15(5):486–489.]

第五届国际癌症控制大会通知

The 5th International Cancer Control Congress (ICCC5)

“第五届国际癌症控制大会”将于 2013 年 11 月 3~6 日在秘鲁首都利马威斯汀酒店举行。此次会议由国际癌症控制协会和秘鲁国家癌症研究所共同主办,世界卫生组织协办。在前四次会议的基础上,本次会议将继续努力提升公众对肿瘤/慢性非传染性疾病的防控意识,促进前沿科技的转化,加强相关人力物力的建设,改善政府机构和社会组织的合作。除此之外,会议还将重点关注肿瘤/慢性感染的防控、卫生系统各部门的整合及协作等内容。

本次会议预计将吸引来自全球各国 500 余名临床及公共卫生相关研究领域的专家学者,并将通过多种形式分享来自各国最新的科研成果、肿瘤防控的策略和经验以及成功的实践案例。

详细征稿范围和注册指南请登陆会议官方网站 www.iccc5.com 参阅相关信息。如有会议注册问题,可发送邮件至 iccc2013-registration@icsevents.com。