

7-1-2015

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Recommended Citation

Jaichaiyaphum, Ong-orn; Khuwatsamrit, Kusuma; and Kanogsunthornrat, Nirobol (2015) "Surgical site infection in patients undergoing urgent abdominal surgery," *Chulalongkorn Medical Journal*: Vol. 59: Iss. 4, Article 4.

DOI: <https://doi.org/10.58837/CHULA.CMJ.59.4.4>

Available at: <https://digital.car.chula.ac.th/clmjournal/vol59/iss4/4>

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Surgical site infection in patients undergoing urgent abdominal surgery

Ong-orn Jaichaiyaphum*

Kusuma Khuwatsamrit** Nirobol Kanogsunthornrat**

Jaichaiyaphum O, Khuwatsamrit K, Kanogsunthornrat N. Surgical site infection in patients undergoing urgent abdominal surgery. Chula Med J 2015 Jul - Aug; 59(4): 377 - 88

- Background** : *Surgical site infection (SSI), is a major problem and the most common complication of surgery. It was considered an essential indicator for a quality of care of hospital. SSI affects patients suffer from increasing morbidity and mortality, prolongs length of stay, delay recovery, decreases quality of life, and increases medical costs. Although urgent abdominal surgery is a significant treatment for patients with life-threatening intraabdominal conditions, it is usually associated with increased risk of SSI. Factors related to SSI need to be explored to help improve healthcare services and surveillance program in high-risk patients.*
- Objective** : *To study SSI incidence and the factors associated with SSI in patients undergoing urgent abdominal surgery.*
- Designs** : *Descriptive retrospective research design.*
- Setting** : *King Chulalongkorn Memorial Hospital, Bangkok, Thailand.*
- Material and Method** : *The data was collected from the medical record. The collected data: age, hospital length of stay, kind of surgical procedure, the duration of surgery, comorbidity, the American Society of Anesthesiologists physical status (ASA), Obesity, preoperative and postoperative Systemic Inflammatory Response Syndrome (SIRS), type of surgical wound (clean, clean-contaminate,*

* Master Student, Master of Nursing Science Program (Adult Nursing), Faculty of Medicine Ramathibodi Hospital, Mahidol University

** Ramathibodi School of Nursing, Faculty of Medicine Ramathibodi Hospital, Mahidol University

contaminate and dirty), blood transfusion, admission to intensive care unit (ICU) after surgery, plasma glucose level, serum albumin level and prophylactic antibiotic. Inclusion criteria comprised patients who were > 16 years old and had urgent abdominal surgery at King Chulalongkorn Memorial Hospital from January 1, 2010, to December 31, 2012. Data was analyzed by using SPSS V.11.5. The relationships were tested by Chi-square, the Fisher exact test and the Odd Ratio was tested by Cochran's and Mantel-Haenzel.

Result : Of 439 patients undergoing urgent abdominal surgery, 93 (21.18%) developed SSI and factors were associated with SSI ($P < .05$) in patients undergoing urgent abdominal surgery, were the American Society of Anesthesiologists physical status (ASA) and preoperative Systemic Inflammatory Response Syndrome (SIRS), the duration of surgery, the type of wound, the use of drainage, blood transfusion, the admission to ICU after surgery, postoperative plasma glucose levels, serum albumin levels, postoperative Systemic Inflammatory Response Syndrome (SIRS) and prophylactic antibiotics.

Conclusion : SSI remains a major problem and the most common complication of surgery, factors related to SSI compare with other study, there is different for some factors. The using result of study to monitor risk factors and to develop the surveillance program in patient with undergoing urgent abdominal surgery, these can improve patients care services.

Keywords : Surgical site infection, risk factors, urgent/emergency abdominal surgery.

Reprint request: Khuwatsamrit K. Ramathibodi School of Nursing, Faculty of Medicine
Ramathibodi Hospital, Mahidol University, Bangkok 10440, Thailand.

E-mail: kusuma.khu@mahidol.ac.th

Received for publication. February 19, 2015.

องค์อร ใจชัยภูมิ, กุสุมา คุววัฒนสัมฤทธิ์, นิโรบล กนกสุนทรรัตน์. การติดเชื้อตำแหน่งแผลผ่าตัดในผู้ป่วยผ่าตัดช่องท้องแบบเร่งด่วน. จุฬาลงกรณ์เวชสาร 2558 ก.ค. – ส.ค.; 59(4): 377 – 88

- เหตุผลของการทำวิจัย** : การติดเชื้อตำแหน่งแผลผ่าตัดเป็นปัญหาที่พบบ่อยในผู้ป่วยศัลยกรรมและเป็นตัวชี้วัดสำคัญของคุณภาพการบริการในโรงพยาบาล มีผลทำให้ผู้ป่วยมีอัตราป่วยอัตราตายเพิ่มขึ้น ต้องนอนพักรักษาในโรงพยาบาลนานขึ้น เสียค่าใช้จ่ายเพิ่มขึ้นและคุณภาพชีวิตลดลง และโดยเฉพาะการผ่าตัดช่องท้องแบบเร่งด่วนซึ่งถือเป็นหนึ่งความเสี่ยงของการติดเชื้อ จึงจำเป็นต้องศึกษาอุบัติการณ์เกิดและปัจจัยที่สัมพันธ์กับการติดเชื้อตำแหน่งแผลผ่าตัดในผู้ป่วยกลุ่มเสี่ยง เพื่อพัฒนาคุณภาพบริการการดูแลและการเฝ้าระวังในผู้ป่วยที่เข้ารับการผ่าตัดช่องท้องแบบเร่งด่วน
- วัตถุประสงค์** : เพื่อศึกษาอุบัติการณ์เกิดการติดเชื้อตำแหน่งแผลผ่าตัดและปัจจัยที่มีผลต่อการติดเชื้อตำแหน่งแผลผ่าตัด ในผู้ป่วยผ่าตัดช่องท้องแบบเร่งด่วน
- รูปแบบงานวิจัย** : การศึกษาเชิงพรรณนาหาความสัมพันธ์ย้อนหลัง (Descriptive retrospective research design)
- สถานที่ทำการศึกษา** : โรงพยาบาลจุฬาลงกรณ์ สภากาชาดไทย กรุงเทพมหานคร
- ตัวอย่างและวิธีการศึกษา** : เก็บรวบรวมข้อมูลผู้ป่วยที่มีอายุตั้งแต่ 16 ปีขึ้นไป ที่ได้รับการผ่าตัดช่องท้องแบบเร่งด่วน และเข้ารับการรักษาที่โรงพยาบาลจุฬาลงกรณ์ สภากาชาดไทย ตั้งแต่ 1 มกราคม 2553 ถึง 31 ธันวาคม 2555 โดยเลือกกลุ่มตัวอย่างแบบเฉพาะเจาะจง จำนวน 439 ราย จากเวชระเบียน บันทึกในแบบประเมินปัจจัยเสี่ยงที่เกี่ยวข้องกับการติดเชื้อตำแหน่งแผลผ่าตัด วิเคราะห์ข้อมูลโดยใช้โปรแกรมสถิติสำเร็จรูป SPSS V.11.5 ทดสอบความสัมพันธ์โดยใช้สถิติ Chi square test และ Fisher exact test และหาค่าอัตราเสี่ยง Odd Ratio โดยการใช้สถิติ Cochran's and Mantel-Haenzel

- ผลการศึกษา :** ผลการวิจัยพบว่ากลุ่มตัวอย่างที่ได้รับการผ่าตัดช่องท้องแบบแรงดัน มีการติดเชื้อตำแหน่งแผลผ่าตัดจำนวน 93 ราย (ร้อยละ 21.18) ปัจจัยที่สัมพันธ์กับการติดเชื้อตำแหน่งแผลผ่าตัดอย่างมีนัยสำคัญทางสถิติ ได้แก่ ระดับความแข็งแรงของร่างกาย การมีกลุ่มอาการตอบสนองต่อการอักเสบทั่วร่างกายก่อนผ่าตัด ระยะเวลาทำผ่าตัด ระดับความสะอาดของแผลผ่าตัด การมีท่อระบาย และการได้รับเลือดระหว่างผ่าตัด การเข้ารับรักษาในหอผู้ป่วยวิกฤตหลังผ่าตัด ระดับน้ำตาลในเลือดระดับแอลบูมินในเลือดหลังผ่าตัด การมีกลุ่มอาการตอบสนองต่อการอักเสบทั่วร่างกายหลังผ่าตัด และการให้ยาปฏิชีวนะแบบป้องกันการติดเชื้อหลังผ่าตัด
- สรุป :** การติดเชื้อตำแหน่งแผลผ่าตัดยังเป็นปัญหาสำคัญทางศัลยกรรม ปัจจัยที่สัมพันธ์กับการติดเชื้อตำแหน่งแผลผ่าตัดบางปัจจัยมีความแตกต่างกับการศึกษาอื่น ผลการศึกษานำไปใช้เพื่อพัฒนาคุณภาพบริการ และคุณภาพการเฝ้าระวังผู้ป่วยกลุ่มเสี่ยงซึ่งอาจลดอุบัติการณ์การติดเชื้อตำแหน่งแผลผ่าตัดได้
- คำสำคัญ :** การติดเชื้อตำแหน่งแผลผ่าตัด, ปัจจัยเสี่ยง, การผ่าตัดช่องท้องแบบแรงดัน.

Surgical site infection (SSI) is a significant problem and the most common complication of surgery.⁽¹⁾ It was considered an essential indicator for measuring the quality of care of hospital. In 2010, a survey of 16 million surgical procedures in the United States found that 31% of all *hospital-acquired infections* (HAIs) were SSI.⁽²⁾ SSI is also the most common complication of surgery related to *HAIs*.⁽²⁾ In Thailand, SSI was the second or third most common cause of HAIs.⁽³⁾ The SSI patients usually suffer from increasing morbidity and mortality⁽⁴⁾, prolonged hospital stay,⁽⁵⁾ delayed recovery, decreased quality of life⁽⁶⁾ and increased medical costs.⁽⁷⁾

Urgent abdominal surgery was define as an operative procedure that is performed within 24 - 48 hours.⁽⁸⁾ Currently, the number of patients undergoing urgent abdominal surgery have increased. Patients can easily access the healthcare service because of the development of healthcare systems and quality of care. It is associated with SSI more than elective abdominal surgery.⁽⁹⁾ Although urgent abdominal surgery is a significant treatment for patients with life-threatening conditions, it is associated with SSI.

Nurses are an important member of the health care team and participate in patient care from admission to discharge. They could expand their role for prevention and surveillance of infection in patients undergoing urgent abdominal surgery with a high risk of SSI.⁽¹⁰⁾ Therefore, nurses have to know the factors associated with SSI in patients undergoing urgent abdominal surgery in order to improve the quality of care and prevent hospital acquired infections.

Material and Methods

Descriptive retrospective research was performed to find out the SSI incidence rate and

the factors associated with SSI in patients undergoing urgent abdominal surgery.

Sampling and Sample size

The subjects in this study were ≥ 16 year olds underwent urgent abdominal surgery at King Chulalongkorn Memorial Hospital (KCMH) from January 1, 2010, to December 31, 2012. They were admitted ≥ 48 hours. All subjects were selected by purposive sampling. The sample size was calculated by G*power⁽¹¹⁾ and the set value, the correlation ρ H0 at 0.2 was used to calculate the sample size in order to cover all the variables.⁽¹²⁾ The level of significance was .05 and the power was 99 percent. The sample size was calculated by G*power and the set value as above was equal to 440 subjects.

Instrumentation and Validity of the instruments.

Instrumentation was developed from a literature review by the researcher. The instrument consisted of selected factors associated with surgical site infection (SSI) in patients undergoing urgent abdominal surgery. They were divided into 3 parts as follows:

Part 1 Demographic and Patient's factors data;

Part 2 Clinical and Operative data;

Part 3 The assessment of surgical site infections.

SSI was diagnosed using the criteria of the United States Center for Disease Control and Prevention (CDC), which came into effect in 1992.⁽¹³⁾

The research instruments were validated by three infectious control specialists and were revised as the comment from experts with content validity index (CVI) = 0.82.

Protection of human subjects

Prior to data collection, approval was obtained from the Human Research Review Committee of the Faculty of Medicine, Chulalongkorn University. Permission was also obtained from the director of King Chulalongkorn Memorial Hospital (KCMH). Permission for the study was given by the KCMH statistics outpatient database. All participants were assured that their data would be kept confidential.

Data collection and data analysis

The researcher collected the patients' data by herself alone. According to the medical records of the Department, medical records provided only within days and business hours and medical records could not be taken outside. Data were collected from January 1, 2010 to December 31, 2012 at a rate of 7 - 10 files per day, 5 days per week.

The researcher defined a code and entered the data into their personal computer. Data analysis was conducted as follows:

1. Demographic data, operative data and surgical site infection data were analyzed by using descriptive statistics (frequency, percentage, mean, median and standard deviation).
2. The relationship between surgical site infection in patients undergoing urgent abdominal surgery and selected factors were analyzed using chi-square and the Fisher exact test. The odd ratio was tested using Cochran's and Mantel-Haenzel.

Result

The total number of patients undergoing urgent abdominal surgery is 439 cases, of which it

was found that there are 93 cases (21.18%) of surgical site infection, including 57 males (61.29%) and 36 females (38.17%). The average age was 59.22 years old, and the minimum age was 17 years old and the maximum age was 98 years old with a standard deviation of 18.07. The age groups are divided on the basis of the ages considered elderly in Thailand. The adult age group (16 - 60 years) contained 48 cases (51.61%), nearly the same as the elderly group (> 60 years), in which there were 45 cases (48.39%) as shown in Table 1.

Ninety-three (21.18%) patients developed SSI, as classified by their infection level. The most common level of SSI was organs and space intraabdomen, of which there were 46 cases (49.46%). Another two levels of SSI found in the superficial tissues, of which there were 42 cases (46.15%) and found in deep tissue, of which there were 5 cases (5.38%). It was also found that the three surgical procedures associated with SSI were small bowel surgery (23 cases, 24.73%), colorectal surgery (22 cases, 23.66%) and gastric surgery (19 cases, 20.43%), as shown in Table 2.

In patients undergoing urgent abdominal surgery, the authors found that age group, comorbidity, obesity, skin preparation, preoperative length of stay and surgical skin closure are not associated with SSI ($p > .05$). In contrast the physical status (ASA score), preoperative SIRS, postoperative SIRS, duration of surgery, type of wound, the use of drainage, blood transfusion, admission to ICU, plasma glucose levels, serum albumin levels, prophylactic antibiotic showed a significant associated with SSI, as shown in table 3.

Table1. Demographic data, the number and percentage of patients undergoing urgent abdominal surgery who developed SSI and not developed SSI (*N* = 439).

Demographic data	SSI N (%)	No SSI N (%)	Total N (%)
Number	93 (21.18)	346 (78.82)	439 (100.00)
Gender Male	57 (22.01)	202 (77.99)	259 (59.00)
Female	36 (20.00)	144 (80.00)	180 (41.00)
Age (years)			
Average	59.22 ± 18.07	58.48 ± 18.15	58.64 ± 18.12
Minimum	17	16	16
Maximum	98	97	98
Age group			
Age16 - 60 years	48 (22.02)	170 (77.98)	218 (49.66)
Age > 60 years	45 (20.36)	176 (79.64)	211 (50.34)
Hospital LOS (day)			
Average	44.16 ± 38.49	20.05 ± 25.05	25.15 ± 30.05
Minimum	5	2	2
Maximum	210	241	241

SSI = Surgical site infection, LOS = *length of stay*

Table 2. Classification of SSI in patients undergoing urgent abdominal surgery and type of surgical procedure (*N* = 93).

Surgical procedure	Classifications of surgical site infection							
	Superficial-SSI		Deep-SSI		Organ/space SSI		Total	
	N	(%)	N	(%)	N	(%)	N	(%)
Small Bowel Surgery	11	(47.80)	0	(0.00)	12	(52.20)	23	(24.73)
Colorectal Surgery	14	(63.60)	2	(9.10)	6	(27.30)	22	(23.66)
Gastric Surgery	10	(52.60)	1	(5.30)	8	(42.10)	19	(20.43)
Explore Laparotomy	1	(10.00)	1	(10.00)	8	(80.00)	10	(10.75)
Hepato-Biliary-								
Pancrease surgery	1	(25.00)	0	(0.00)	3	(75.00)	4	(4.30)
Open Repair Aneurysm	0	(0.00)	1	(25.00)	3	(75.00)	4	(4.30)
Appendectomy	2	(100.00)	0	(0.00)	0	(0.00)	2	(2.15)
Splenectomy	2	(100.00)	0	(0.00)	0	(0.00)	2	(2.15)
Other	1	(14.00)	0	(0.00)	6	(85.70)	7	(7.53)
Total	42	(45.16)	5	(5.38)	46	(49.46)	93	(100.00)

SSI = Surgical site infection

Table 3. The relationship between risk factors and SSI in patients undergoing urgent abdominal surgery.
(N = 439)

Factor	SSI No (%)		X ²	p	OR	95% CI Lower - upper
	No	Yes				
Age group (yrs)						
16 - 60	170 (77.98)	48 (22.02)	0.95	0.76		
> 60	176 (79.64)	45 (20.36)				
Comorbidity						
No	201 (80.72)	48 (19.28)	1	0.31		
Yes	201 (80.72)	48 (19.28)				
Obesity						
BMI < 30 kg/m ²	336 (79.06)	89 (20.94)	0.13	0.72		
BMI ≥ 30 kg/m ²	10 (71.43)	4 (28.57)				
Physical status (ASA)						
ASA = 1	81 (86.17)	13 (13.83)	10.95	0.00**		Reference
ASA = 2	129 (83.23)	26 (16.77)			1.25	0.61 - 2.58
ASA = 3	99 (72.26)	38 (27.74)			2.39	1.19 - 4.98
ASA = 4	37 (69.81)	16 (30.19)			2.69	1.18 - 6.17
Skin preparation						
Complete	342 (78.62)	93 (21.38)	0.18	0.67		
Not complete	4 (100.00)	0 (0.00)				
Preoperative LOS						
≤ 3 days	291 (80.61)	70 (19.39)	3.33	0.07		
> 3 days	55 (70.51)	23 (29.49)				
Preoperative SIRS						
No SIRS	170 (83.33)	34 (16.67)	4.17	0.04*	1.68	1.05 - 2.69
SIRS	176 (74.89)	59 (25.11)				
Duration of surgery						
≤ 75 th percentile	281 (81.21)	65 (18.79)	4.97	0.03*	1.86	1.11 - 3.13
> 75 th percentile	65 (69.89)	28 (30.11)				
Surgical skin closure						
Closure	256 (81.27)	59 (18.73)	3.52	0.06		
Not closure	90 (72.58)	34 (27.42)				
Type of wound						
Clean	28 (96.55)	1 (3.45)	23.96	0.00**		Reference
Clean-Contaminated	103 (87.29)	15 (12.71)			4.08	0.52 - 32.21
Contaminated	213 (74.74)	72 (25.26)			9.46	1.26 - 70.82
Dirty	2 (28.57)	5 (71.43)			70	5.29 - 925.86

Table 3. The relationship between risk factors and SSI in patients undergoing urgent abdominal surgery.
(N = 439) (Continuous)

Factor	SSI No (%)		X ²	p	OR	95% CI Lower - upper
	No	Yes				
Drainage						
No	196 (85.22)	34 (14.78)	11.07	0.00**	2.27	1.41 - 3.64
Yes	150 (71.77)	59 (28.28)				
Blood transfusion						
No	227 (83.46)	45 (16.54)	10.51	0.01**		Reference
< 3 unit	60 (75.00)	20 (25.00)			1.68	0.92 - 3.06
≥ 3 unit	59 (67.82)	28 (32.18)			2.39	1.38 - 4.16
Admission to ICU						
No	233 (87.59)	33 (12.41)	29.83	0.00**	3.75	2.32 - 6.06
Yes	113 (65.32)	60 (34.68)				
Plasma glucose						
≤ 200 mg/dl	338 (79.91)	85 (20.09)	6.56	0.01*	3.98	1.42 - 10.90
> 200 mg/dl	8 (50.00)	8 (50.00)				
Serum albumin						
≥ 3.0 gm/dl	210 (84.34)	39 (15.66)	9.76	0.00**	2.14	1.34 - 3.40
< 3.0 gm/dl	136 (71.58)	54 (28.42)				
Postoperative SIRS						
No SIRS	237 (87.13)	35 (12.87)	28.33	0.00**	3.6	2.24 - 5.80
SIRS	109 (65.27)	58 (34.73)				
Prophylactic AB						
Yes	26 (100.00)	0 (00.00)	6.14	0.01*	0.06	0.00 - 1.07
No	320 (77.48)	93 (22.52)				

SSI = Surgical site infection, CI = confidence interval, BMI = Body mass index, ASA = American Society of Anesthesiology, LOS = Length of stay, SIRS = Systemic Inflammatory Response Syndrome, AB = Antibiotic, ICU = Intensive care unit
* = P < 0.05, ** = P < 0.01

Discussion

SSI is a significant problem and the most common complication of surgery.⁽¹⁾ Urgent abdominal surgery affected surgical site infection.⁽⁹⁾ The study found that 93 (21.18%) patients developed SSI, urgent gastrointestinal surgeries were at higher risk for SSI more than other urgent/emergency abdominal surgeries.

Patient's factors associated with SSI, the American Society of Anesthesiologists physical status (ASA), preoperative SIRS, postoperative SIRS, its showed that patients had severe clinical condition, higher morbidity and mortality, therefore it was at higher risk for SSI.⁽¹⁴⁾ These pathologies of acute abdomen increase the spread of local

microorganisms from the abdomen to the adjacent organs. The inflammation and infection process may cause impairment of various systems in the body. Although urgent surgery is necessary in order to correct the pathogenesis, it carries the risk of SSI due to the amount of contaminants in the tissue.⁽¹⁵⁾ High plasma glucose diminishes immunity functions, such as the motion of polymorphonuclear leukocyte (PMN) becoming slower or impairment of phagocytosis process, therefore increases the risk of SSI⁽¹⁶⁾ serum albumin level is essential for wound healing. If the levels of serum albumin is low, the SSI rate would increase and delay wound healing.⁽¹⁷⁾

The factors affected pathogens that cause of SSI, perioperative prophylactic antibiotic, antibiotics should not be given to patients longer than 24 hours after the surgery because the microorganisms could increase drug resistance.⁽¹⁸⁾ Receiving blood transfusion during surgery, which could affect the function of antigens presenting cell decreases, causing the number of T-helper cells and monocytes to decrease, therefore SSI would increase.⁽¹⁹⁾

The factors affected environment, the surgery longer than the 75th percentile of the surgical duration, surgery which has taken for a long time that causes cells and tissues to be destroyed from cold and air in the operating rooms that lack proper hydration. It also results in long exposure and contamination from the environment. The abdominal tissue is long held with retractors and the stability of the antibiotic decreased, affecting the body's defense mechanism for preventing microorganism impairment.⁽²⁰⁾ In addition, the effect of anesthesia and surgical procedure, oxygen perfusion of tissue decreased⁽¹⁷⁾ and admission to ICU after surgery,

these increase the risks to patients because of longer exposure to drug resistant pathogens in ICU. This study was consistent with a study in abdominal traumatic patients, found that admission to ICU was associated with SSI⁽²¹⁾

In comparison with the results of other study^(17, 21 - 22), the 21.18%, incidence of SSI found in this study was similar, but factors associated with SSI were different in some factors. In this study, age, comorbidity and obesity were not associated with SSI, the American Society of Anesthesiologists physical status (ASA), the type of wound, preoperative-postoperative SIRS, plasma glucose levels and serum albumin levels were associated with SSI, these was similar other study. For perioperative variable, duration of surgery, the use of drainage, prophylactic antibiotic, blood transfusion and admission to ICU after surgery were associated with SSI. Form this study, the authors study only patients undergoing urgent abdominal surgery, most of previous study studied including elective and urgent/emergency abdominal surgery, therefore the use of result study, it should be the same as population, same as situation and the following process of care such as prophylactic antibiotic policy, reduction of duration surgery, proper admission ward after surgery and develop SSI surveillance system.

Conclusion

Ninety-three (21.18%) patients developed SSI. The physical status (ASA score), preoperative SIRS, postoperative SIRS, length of surgery, wound, drainage, blood transfusion, admission to ICU, plasma glucose levels, serum albumin levels, prophylactic antibiotic showed a significant associated with SSI.

SSI remains a major problem and the most common complication of surgery. To improve quality of care in patients undergoing urgent abdominal surgery and to develop a surveillance system, these can reduce surgical site infection.

Acknowledgements

I would like to thanks all lecturers of Master of Nursing Science Program (Adult Nursing), Faculty of Medicine Ramathibodi Hospital, Mahidol University, Faculty of Medicine Chulalongkorn University and King Chulalongkorn Memorial Hospital for their suggestion in this study and their kind supports.

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