Microalbuminuria Correlates with Endothelial Injury and Multiple Organ Dysfunction

— A Preliminary Study —

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ABSTRACT An early feature of acute respiratory distress syndrome and multiple organ dysfunction syndrome is vascular endothelial cell injury and subsequent increase in generalized microvascular permeability. It has recently been postulated that the level of microalbuminuria represents generalized microvascular permeability in the clinical setting. The purpose of this study was to ascertain whether the extent of microalbuminuria correlates with the level of endothelial cell injury, the severity of illness, and the magnitude of impaired respiratory function and multiple organ dysfunction in patients who required therapeutic interventions. **Methods :** Fourteen consecutive ICU patients who required emergent operation or non-invasive interventions were studied. Urine albumin/creatinine ratio (ACR) and the circulating markers of endothelial cell injury, i.e., serum thrombomodulin (TM) and plasma von Willebrand factor antigen (vWF), were measured within 24 hours after intervention. The data of Acute Physiology and Chronic Health Evaluation II score (APACHE II), simplified acute physiology score (SAPS), multiple organ dysfunction score (MODs), sequential organ failure assessment (SOFA), $\text{PaO}_2/\text{FiO}_2$ ratio, lung injury score (LIS), white blood cell count (WBC) in the blood, and serum C-reactive protein (CRP) were obtained daily during the first 7 days. The relationships between ACR and other variables were assessed. **Results :** During the first 24 hours after intervention, there was an increase in ACR (280 ± 86 mg/g) above normal value (< 10 mg/g). Log ACR showed a significant correlation with serum TM, but not with plasma vWF. When the levels of Log ACR were compared to other clinical variables obtained within the first 24 hours, the increase in Log ACR correlated positively with APACHE II, SAPS, MODs, SOFA and LIS. Log ACR correlated negatively with $\text{PaO}_2/\text{FiO}_2$ ratio. Log ACR did not correlate with WBC, or CRP. When the levels of Log ACR were compared to the worst data of those variables measured during the first week, Log ACR correlated positively with the worst data of APACHE II, SAPS, MODs, SOFA, and LIS. Log ACR correlated negatively with the worst data of $\text{PaO}_2/\text{FiO}_2$ ratio. Log ACR did not show any relation with WBC, or CRP. **Conclusion :** The extent of urinary ACR measured during the first 24 hours after intervention correlated with the level of endothelial cell injury, the severity of illness, and the magnitude of impaired respiratory function and multiple organ dysfunction. These findings appear to support the hypothesis that microalbuminuria represents the magnitude of generalized microvascular permeability. (JJAAM 2000 ; 11 : 261-8)

Key Words : microalbuminuria, multiple organ failure, acute respiratory distress syndrome, endothelium, vascular permeability

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INTRODUCTION

An early feature of acute respiratory distress syndrome and multiple organ dysfunction syndrome is vascular endothelial cell injury and subsequent increase in generalized microvascular permeability¹⁾. Low-level albumin excretion, i.e., microalbuminuria,

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has been recognized as a predictor of nephropathy in patients with diabetes mellitus²). Recently, increased urine albumin excretion has also been observed in a non-diabetic population in association with trauma, burn injury, aortic aneurysm surgery, pancreatitis, peripheral vascular disease, hypertension, and coronary heart disease³⁻⁹). Increased glomerular permeability to plasma proteins occurred within 30 minutes to 4 hours of injury or surgery, and was proportional to the magnitude of the insult^{4,5}). This evidence led to the hypothesis that increased glomerular and vascular permeability occur simultaneously, and may share common pathways during the early stages of acute systemic inflammation.

In this study we measured the levels of urinary albumin excretion in patients who required surgical or non-invasive interventions, and ascertained whether the extent of microalbuminuria correlates with the level of endothelial cell injury, the severity of illness, and the magnitude of impaired respiratory function and multiple organ dysfunction.

MATERIALS AND METHODS

This study was conducted during a 4-months period in the medical and surgical ICU of an urban university tertiary care hospital that functions also as a level I trauma center. We studied 14 consecutive patients who directly admitted to the intensive care unit and required emergent operation or other non-invasive interventions. The exclusion criteria were: a) a history of chronic nephropathy requiring hemodialysis, endocrine diseases, or malignancies; b) multiple trauma; and c) thermal injury. This investigation was approved in advance by the Institutional Research Review Board.

The balloon catheter was inserted without difficulty in all patients. A previous study has shown that uncomplicated catheterization does not alter urinary albumin excretion³). Two ml of urine was collected during the first 24 hours after intervention and aliquots stored at -80°C . Blood samples were also taken from an arterial line at the same time. After blood was kept at room temperature for 10 minutes, serum was separated by centrifuging at $3,000 \times g$ at 4°C for 15 minutes. Blood was also collected in 3-ml tubes containing sodium citrate (0.13 mol/l) and immediately centrifuged at $3,000 \times g$ at 4°C for 15 minutes. The sera and plasma were divided into suitable aliquots and snap-frozen at -80°C until

assay.

All clinical variables analyzed in this study were calculated retrospectively from raw data collected prospectively. Acute physiology and chronic health evaluation (APACHE) II score¹⁰), the simplified acute physiology score (SAPS)¹¹), $\text{PaO}_2/\text{FiO}_2$ ratio, the lung injury score (LIS)¹²), the multiple organ dysfunction score (MODs)¹³), and the sequential organ failure assessment (SOFA)¹⁴) were calculated daily during the first week as described in the original reports.

Urinary microalbumin was measured by a latex agglutination method, and was expressed as the urinary albumin to creatinine ratio (ACR) in mg/g creatinine to correct for variations in urine flow rate¹⁵). Since urinary ACR showed a skewed distribution, it was logarithmically transformed.

Serum levels of thrombomodulin were determined by a one-step sandwich enzyme immunoassay¹⁶). Plasma levels of von Willebrand Factor antigen were measured by ELISA (Asserachrom VIIIR:Ag, Boehringer Mannheim, Germany)¹⁷). The data of white blood cell count (WBC) in the circulation and serum concentrations of C-reactive protein (CRP) were obtained from the routine laboratory tests.

The data are expressed as mean $\pm$ SEM. The statistical analysis was assessed with the Spearman rank correlation for linear regression. A p value of less than 0.05 was considered as statistically significant.

RESULTS

Patient characteristics and clinical details are shown in **Table 1**. One patient (patient No.7) expired within 7 days after intervention. During the first 24 hours after intervention, there was an increase in ACR ($280 \pm 86 \text{ mg/g}$) above normal value ($<10 \text{ mg/g}$). Log ACR correlated positively with serum thrombomodulin ($6.8 \pm 1.2 \text{ FU/ml}$, range 2.6-19.5 FU/ml; normal $<4.5 \text{ FU/ml}$; **Fig.1**), but not with plasma von Willebrand factor antigen ($260 \pm 48\%$, range 95-680%; normal 50-155%; **Fig. 1**). When the levels of Log ACR were compared to other clinical variables obtained within the first 24 hours, the increase in Log ACR correlated positively with APACHE II (13 ± 2 , range 0-30; **Fig.2**), SAPS (11 ± 1 , range 2-18; **Fig. 2**), MODs (6 ± 1 , range 0-14; **Fig. 3**), SOFA (7 ± 2 , range 0-17; **Fig. 3**), and LIS (0.7 ± 0.2 , range 0-2.7; **Fig. 4**). Log ACR correlated negatively with $\text{PaO}_2/\text{FiO}_2$ ratio (332 ± 40 , range 78-583; **Fig. 4**).

Table 1. Summary of patients.

No.	G.	Age	Primary Diagnosis	Intervention	Clinical course
1	M	50	cholecystitis, peritonitis, MODS	operation	→
2	M	75	AAA rupture, shock	operation	↓
3	M	44	gastric perforation, peritonitis	operation	↑
4	M	61	SMA occlusion	operation	→
5	M	60	gastric cancer	operation	↑
6	M	44	intestinal injury, shock	operation	↑
7	M	83	AAA rupture without shock	operation	↓
8	F	76	AAA rupture, shock	operation	↑
9	M	41	CBD infection, sepsis, MODS	endoscopy	→
10	M	66	gastric ulcer bleeding	endoscopy	↓
11	M	50	gastric ulcer bleeding	endoscopy	↑
12	M	55	gastric ulcer bleeding	endoscopy	↑
13	M	47	gastric ulcer bleeding	endoscopy	↑
14	M	46	lumbar artery rupture	TAE	↓

No. = Patient number ; G. = Gender ; Clinical course = Clinical course during the first week after intervention ; MODS = multiple organ dysfunction syndrome ; AAA = abdominal aortic aneurysm ; SMA = superior mesenteric artery ; CBD = common bile duct ; TAE = transarterial embolization ; → = not changed ; ↓ = worsened ; ↑ = recovered

Log ACR did not show any correlation with WBC ($13,900 \pm 2,300/\mu\text{l}$, range 2,000-31,500/ μl ; **Fig. 5**) or CRP (6.5 ± 2.5 mg/dl, range 0-32.6 mg/dl ; **Fig. 5**).

The levels of Log ACR assessed within 24 hours were also compared to the worst data of the variables obtained during the first 7 days (**Table 2**). Log ACR correlated positively with APACHE II (15 ± 3 , range 2-39), SAPS (13 ± 2 , range 3-26), MODs (7 ± 2 , range 0-17), SOFA (8 ± 2 , range 0-23), and LIS (1.1 ± 0.3 , range 0-3.7). Log ACR correlated negatively with $\text{PaO}_2/\text{FiO}_2$ ratio (297 ± 46 , range 47-583). Log ACR did not correlate with WBC ($16,900 \pm 2,400/\mu\text{l}$, range 7,800-36,000/ μl) or CRP (12.2 ± 3.0 mg/dl, range 0-35.2 mg/dl).

DISCUSSION

Microalbuminuria is defined as a subclinical increase in urinary albumin from 20 to 300 mg/l. This cannot be measured by routine laboratory tests and is estimated by radioimmunoassay¹⁸⁾. Microalbuminuria occurs in various pathologic states, such as diabetes mellitus, trauma, and major surgery, all of which are associated with an increase in capillary permeability^{2, 3, 5)}. It, therefore, has been

proposed that microalbuminuria serves to reflect a generalized microvascular permeability³⁾. Pulmonary capillary permeability and generalized vascular permeability have been measured by isotopic methods^{19, 20)}. Increased vascular permeability to radiolabelled albumin in the lung following burn injury²¹⁾ and in the general microvasculature following surgery¹⁸⁾ have been described over similar time periods. In an animal model, simultaneous increases in peripheral vascular and glomerular permeability to labelled macromolecules have been demonstrated within 60 minutes after laparotomy²²⁾.

The kidney is uniquely placed to amplify small changes in vascular permeability³⁾. The renal blood supply, representing 25% of the cardiac output, is filtered through a large surface area lined with fenestrated endothelium. Approximately 180 L of filtrate is produced each day, of which over 99% is reabsorbed by the renal tubules. In an adult, about 70 kg of plasma albumin passes daily through the kidneys, yet only 8 g (0.011%) reaches the renal tubules. The tubules reabsorb the majority, leaving approximately 10 mg/l which is excreted in the urine. A 1% increase in vascular permeability means that an additional 80 mg of albumin enters the tubules, and since the reabsorptive capacity of the tubules for albumin is near saturation, urinary albumin content rises from 10 to 90 mg/l. Thus the kid-

Fig. 1. Top = correlation between serum thrombomodulin and Log [urine albumin/creatinine ratio] (Log ACR). Bottom = correlation between plasma von Willebrand factor antigen and Log ACR. r , coefficient of correlation.

Fig. 2. Top = correlation between Acute Physiology and Chronic Health Evaluation II score (APACHE II) and Log [urine albumin/creatinine ratio] (Log ACR). Bottom = correlation between Simplified acute physiology score (SAPS) and Log ACR. r , coefficient of correlation.

Fig. 3. Top = correlation between multiple organ dysfunction score (MODs) and Log [urine albumin/creatinine ratio] (Log ACR). Bottom = correlation between sequential organ failure assessment (SOFA) and Log ACR. r , coefficient of correlation.

Fig. 4. Top = correlation between $\text{PaO}_2/\text{FiO}_2$ ratio (P/F) and Log [urine albumin/creatinine ratio] (Log ACR). Bottom = correlation between lung injury score (LIS) and Log ACR. r , coefficient of correlation.

Fig. 5. Top = correlation between white blood cell count (WBC) and Log [urine albumin/creatinine ratio] (Log ACR). Bottom = correlation between C-reactive protein (CRP) and Log ACR. r , coefficient of correlation.

neys can convert a 1% increase in vascular permeability to a ninefold increase in urinary albumin content, an amplification of 900 times.

In the present study, urine ACR correlated with the concentrations of serum thrombomodulin, but not with the levels of von Willebrand factor antigen. Thrombomodulin is an endothelial proteoglycan endowed with powerful anticoagulant activity and was found to be present on the whole endothelium of blood and lymph vessels²³. Because soluble thrombomodulin appeared in the cell supernatant only after endothelial cell damage *in vitro*, serum thrombomodulin has been considered as a reliable marker of endothelial damage²⁴. On the other hand, Von Willebrand factor is a large glycoprotein synthesized by vascular endothelial cells. However, von Willebrand factor is considered to originate not only from injured endothelial cells but also from viable endothelial cells activated by pathological triggers²⁵. This glycoprotein has been shown to increase in plasma during clinical conditions such as hypoglycemia, liver cirrhosis, renal failure, pregnancy, diabetes, muscular exercise, and central nervous system stimulation²⁶. Activated platelets are also known to release von Willebrand factor²⁷. In addition,

Table 2. Relation between Log ACR within 24 hours and the worst data of other variables during the first week.

	Coefficients of correlation	
	r	p Value
APACHE II	0.581	0.004*
SAPS	0.768	0.004*
MODs	0.769	0.002*
SOFA	0.771	0.002*
PaO ₂ /FiO ₂	-0.773	0.001*
LIS	0.523	0.009*
WBC	0.386	0.17 ^{NS}
CRP	0.487	0.08 ^{NS}

Log ACR = Log [urine albumin/creatinine ratio]; APACHE II = acute physiology and chronic health evaluation II score; SAPS = simplified acute physiology score; MODs = multiple organ dysfunction score; SOFA = sequential organ failure assessment; LIS = lung injury score; WBC = white blood cell count; CRP = C-reactive protein; r = coefficient of correlation

* $p < 0.05$ ^{NS} not significant

tion, von Willebrand factor has been poorly validated *in vivo* by suitable animal experiments that have attempted to correlate the changes in plasma levels of this glycoprotein with the degree and extent of vascular damage²⁸. Taken together, urine ACR is likely to correlate with the level of endothelial injury.

Significant correlation was observed between urine ACR and APACHE II or SAPS obtained within the first 24 hours. The levels of urine ACR measured within 24 hours after intervention also correlated with the worst scores of APACHE II and SAPS calculated during the first 7 days. These findings are contrary to the findings that De Gaudio et al. demonstrated²⁹. They evaluated the relationship between an increase in urinary ACR, the magnitude of trauma, and the severity of illness. Patients with trauma showed an increase in urine ACR during the first 24 hours after injury. The magnitude of this increase was correlated with the injury severity score, but not with APACHE III or SAPS II. They speculated that urine ACR did not correlate to the severity of illness because the APACHE II and SAPS methods were developed only for the estimation of severity of illness and outcome in intensive care unit patients. No study has yet been performed to evaluate the relationship between urine ACR and the severity of illness in other clinical settings.

Urine ACR correlated with MODs, SOFA, $\text{PaO}_2/\text{FiO}_2$ ratio, and LIS of the same day. The magnitude of urine ACR also correlated with the worst levels of multiple organ dysfunction or impaired respiratory function during the first week. These findings may support the concept that increased systemic microvascular permeability precedes the development of multiple organ dysfunction syndrome. Gosling et al. tested the hypothesis that impaired pulmonary function was associated with urine ACR in trauma patients^{3,30)}. During the first 3 days after trauma, Log ACR and $\text{PaO}_2/\text{FiO}_2$ ratio were inversely related on each study day. When patients were limited to injury severity score >18 , the albumin excretion rate measured 8 hours after admission was significantly higher in patients who subsequently suffered from acute respiratory distress syndrome or acute lung injury than in patients without impaired lung function. They concluded that the capillary leak associated with the subsequent development of pulmonary dysfunction and acute respiratory distress syndrome can be detected by the level of microalbuminuria detected within 8 hours after admission, thus providing a means of early identification of patients at greatest risk and allowing for early intervention. In septic patients, De Gaudio et al. measured urine ACR and SOFA before and after sepsis developed. They noticed that the changes in urine ACR correlated with the increase of SOFA, but not with the alteration of $\text{PaO}_2/\text{FiO}_2$ ratio³¹⁾.

In summary, we have shown in patients, who required urgent operations or non-invasive interventions, that the extent of microalbuminuria correlates with the level of endothelial cell injury, the severity of illness, and the magnitude of impaired respiratory function and multiple organ dysfunction. The extent of microalbuminuria did not correlate with WBC or CRP. These findings appear to support the hypothesis that urinary ACR represents the magnitude of generalized microvascular permeability. This study was conducted using a small number of patients with a limited category of diseases. Serial measurements of urinary ACR, thrombomodulin and von Willebrand factor were also not performed. Further study will be needed to confirm this hypothesis.

References

- 1) Wang X, Anderson R : The role of endothelial cells in the systemic inflammatory response syndrome and multiple system organ failure. *Eur J Surg* 1995 ; 161 : 703-13.
- 2) Viberti GC, Hill RD, Jarrett RJ, et al : Microalbuminuria as a predictor of clinical nephropathy in insulin-dependent diabetes mellitus. *Lancet* 1982 ; 1 : 1430-2.
- 3) Gosling P, Sanghera K, Dickson G : Generalized vascular permeability and pulmonary function in patients following serious trauma. *J Trauma* 1994 ; 36 : 477-81.
- 4) Gosling P, Sutcliffe AJ, Cooper MACS, et al : Burn and trauma associated proteinuria : the role of lipid peroxidation, renin and myoglobin. *Ann Clin Biochem* 1988 ; 25 : 53-9.
- 5) Smith FCT, Gosling P, Sanghera K, et al : Microproteinuria predicts the severity of systemic effects of reperfusion injury following infrarenal aortic aneurysm surgery. *Ann Vasc Surg* 1994 ; 8 : 1-5.
- 6) Shearman CP, Gosling P, Walker KJ, et al : Is low proteinuria an early predictor of a severity of acute pancreatitis? *J Clin Pathol* 1989 ; 42 : 1132-5.
- 7) Matsushita M, Nishikimi N, Sakurai T, et al : Urinary microalbumin as a marker for intermittent claudication. *Eur J Vasc Endovasc Surg* 1996 ; 11 : 421-4.
- 8) Harford M, Wendelhag I, Berglund G, et al : Cardiovascular and renal effects of long-term antihypertensive treatment. *JAMA* 1988 ; 259 : 2553-7.
- 9) Gosling P, Hughes EA, Reynolds TM, et al : Microalbuminuria is an early response following acute myocardial infarction. *Eur Heart J* 1991 ; 12 : 508-13.
- 10) Knaus WA, Draper EA, Wagner DP, et al : APACHE II ; a severity of disease classification system. *Crit Care Med* 1985 ; 13 : 818-29.
- 11) Le Gall JR, Loirat P, Alperovitch A, et al : A simplified acute physiology score for ICU patients. *Crit Care Med* 1984 ; 12 : 975-7.
- 12) Murray JF, Matthay MA, Luce JM, et al : An expanded definition of the adult respiratory distress syndrome. *Am Rev Respir Dis* 1988 ; 138 : 720-3.
- 13) Marshall JC, Cook DJ, Christou NV, et al : Multiple organ dysfunction score : a reliable descriptor of a complex clinical outcome. *Crit Care Med* 1995 ; 23 : 1638-52.
- 14) Vincent JL, Moreno R, Takala J, et al : The SOFA (Sepsis-related Organ Failure Assessment) score to describe organ dysfunction/failure. *Intensive Care Med* 1996 ; 22 : 707-10.
- 15) Ishii S, Wada M, Yamada T, et al : Latex turbidimetric immunoassay with LA-system for urinary albumin. *Japanese Journal of Clinical Laboratory Automation* 1987 ; 12 : 144-8(in Japanese).
- 16) Kodama S, Uchijima E, Nagai M, et al : One-step sandwich enzyme immunoassay for soluble human thrombomodulin using monoclonal antibodies. *Clin Chim Acta* 1990 ; 192 : 191-9.
- 17) Bartlett A, Dormandy KM, Hawkey CM, et al : Factor-VIII related antigen : measurement by enzyme immunoassay.

- Br Med J 1976 ; 1 : 994-6.
- 18) Dezier JF, Le Reun M, Poirier JY : Usefulness of the urinary albumin/creatinine ratio in screening for microalbuminuria. Presse Med 1988 ; 17 : 897-900 (in French).
- 19) Fleck A, Raines G, Hawker F, et al : Increased vascular permeability : a major cause of hypoalbuminaemia in disease and injury. Lancet 1985 ; 1 : 781-4.
- 20) Sturm JA, Wisner DH, Oestern HJ, et al : Increased lung capillary permeability after trauma:a prospective clinical study. J Trauma 1986 ; 26 : 409-18.
- 21) Till GO, Beauchamp C, Menapace D, et al : Oxygen radical dependent lung damage following thermal injury to rat skin. J Trauma 1983 ; 23 : 269-77.
- 22) Shearman CP, Gosling P, Simms MH, et al : Glomerular permeability to large molecules : a marker of vascular permeability? Br J Surg 1988 ; 75 : 1273.
- 23) Boffa MC : Considering cellular thrombomodulin distribution and its modulating factors can facilitate the use of plasma thrombomodulin as a reliable endothelial marker? Haemostasis 1996 ; 26 (Suppl 4) : 233-43.
- 24) Ishii H, Uchiyama H, Kazama M : Soluble thrombomodulin antigen in conditioned medium is increased by damage of endothelial cells. Thromb Haemost 1991 ; 65 : 618-23.
- 25) Mannucci PM : von Willebrand factor:a marker of endothelial damage? Arterioscler Thromb Vasc Biol 1998 ; 18 : 1359-62.
- 26) Brozovic M : Physiological mechanisms in coagulation and fibrinolysis. Br Med Bull 1977 ; 33 : 231-8.
- 27) Mannucci PM : Platelet von Willebrand factor in inherited and acquired bleeding disorders. Proc Natl Acad Sci USA 1995 ; 92 : 2428-32.
- 28) Brinkhous KM, Sultz DL, Reddick RL, et al : Elevated plasma von Willebrand factor levels (vWF) as an index of acute endothelial injury : use of a hypotonic injury model in rats. Fed Proc 1980 ; 39 : 630.
- 29) De Gaudio AR, Spina R, Di Filippo A, et al : Glomerular permeability and trauma : a correlation between microalbuminuria and injury severity score. Crit Care Med 1999 ; 27 : 2105-8.
- 30) Pallister I, Gosling P, Alpar K, et al : Prediction of post-traumatic adult respiratory distress syndrome by albumin excretion rate eight hours after admission. J Trauma 1997 ; 42 : 1056-61.
- 31) De Gaudio AR, Grechi S, Di Filippo A, et al : Glomerular permeability and sepsis : A correlation between microalbuminuria and SOFA score. Crit Care Med 1998 ; 26 : S216.

微量アルブミン尿症の程度は血管内皮障害と多臓器障害の程度と相関する

— 治療的インターベンションを必要とした症例における予備的検討 —

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要旨 重症患者では組織の微小血管の透過性亢進は血管内皮障害に伴って発生し、急性肺障害や多臓器機能低下の初期段階から出現すると考えられている。近年、尿中に微量に存在するアルブミン量が臨床における全身の微小血管の透過性の変化を反映するのではないかと指摘されている。そこでわれわれは、治療のために何らかのインターベンションを必要とした症例を対象に、尿中アルブミン・クレアチニン比（ACR）が病態の重症度、多臓器障害、呼吸障害の程度と相関するかどうかを、血管内皮障害の指標である thrombomodulin（TM）、von Willebrand factor antigen（vWF）と共に比較検討した。症例は手術あるいはその他の治療的インターベンションを緊急に施行した14例で、インターベンション後24時間以内の部分尿と血液を採取し、Log ACRとTM、vWFとの関係、またLog ACRとその後1週間のAPACHE II、simplified acute physiology score（SAPS）、multiple organ dysfunction score（MODs）、sequential organ failure assessment（SOFA）、 $\text{PaO}_2/\text{FiO}_2$ （P/F）、lung injury score（LIS）、末梢血白血球数（WBC）、血清C-reactive protein（CRP）との関係を調べた。Log ACRはTMと相関したが、vWFとは相関しなかった。Log ACRは、インターベンション後24h以内のAPACHE II、SAPS、MODs、SOFA、LISとは正の相関を、P/Fとは負の相関を示した。またLog ACRは、その後連日7日間計測したこれらのスコアの最悪の数値とも同様の相関を示した。Log ACRはWBC、CRPとは相関を示さなかった。以上より、インターベンション後24時間以内に測定した尿中アルブミン・クレアチニン比は病態の重症度や、血管内皮障害、多臓器障害、呼吸機能障害の程度と相関することが判明した。この結果は、微量アルブミン尿症の程度は全身性に発生した微小血管の透過性亢進の程度を反映するという仮説を支持するように思われた。

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キーワード：アルブミン尿症，多臓器不全，急性呼吸促進症候群，血管内皮，血管透過性

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