

New Guideline in Blood Glucose Control

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Outline

1. Hyperglycemia
2. Hyperglycemia & Sepsis
3. New Guideline in Blood Glucose Control

Hyperglycemia

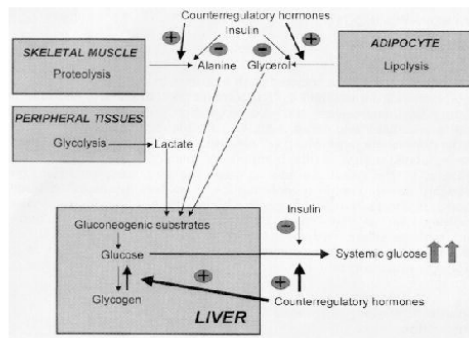
- Hyperglycemia is common in critically ill patients.
- Approximately 90% of patients treated in an ICU developing blood glucose concentrations > 110 mg/dl
- Stress-induced hyperglycemia (SIH)

Pathophysiology

Metabolic changes in response to stress of illness

- ↓ Insulin secretion
- ↑ Insulin resistance
- ↑ Stress hormones (cortisol, catecholamines, GH, glucagon)
- ↑ cytokines (TNF α , IL-1)
- Results in gluconeogenesis, glycogenolysis, lipolysis, proteolysis

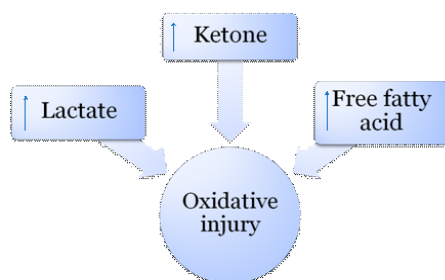
Factors Promoting Gluconeogenesis



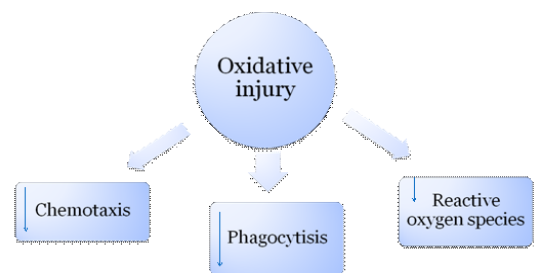
Effects of Hyperglycemia

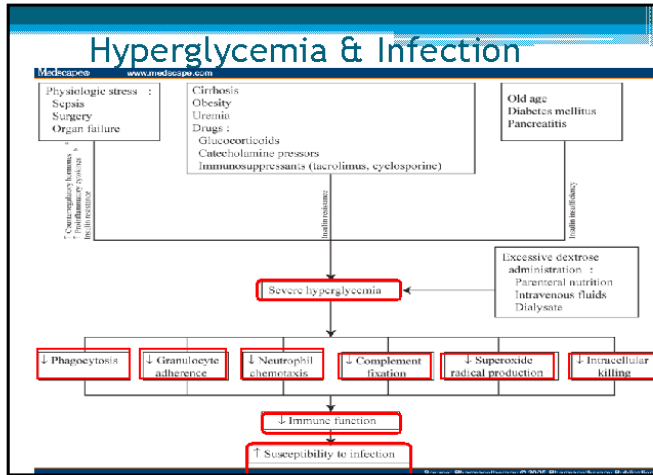
- Fluid balance (Glycouria ,dehydration)
- Immune function
- Inflammation
- Neural tissue ischemia → damage
- Endothelial cell change → Atherosclerosis

Effects of Hyperglycemia



Effects of Hyperglycemia





New Guideline in Blood Glucose Control

Glucose Testing and Interpretation		
Test	Result	Diagnosis
Fasting plasma glucose, mg/dL	≤99	Normal
	100-125	Impaired fasting glucose
	≥126	Diabetes, confirmed by repeating the test on a different day
Glucose, mg/dL (oral glucose tolerance test, 2 hours after ingestion of 75-g glucose load)	≤139	Normal
	140-199	Impaired glucose tolerance
	≥200	Diabetes, confirmed by repeating the test on a different day
Hemoglobin A _{1c} , % (as a screening test)	<5.4	Normal
	5.5-6.4	High risk/prediabetes; requires screening by glucose criteria
	≥6.5	Diabetes, confirmed by repeating the test on a different day

AACE Diabetes Care Plan Guidelines, Endocr Pract. 2011;17(Suppl.2)

New Guideline in Blood Glucose Control

• SUGAR

- S = Set the Right Target
- U = Underlying causes
- G = Glucose monitoring
- A = Avoid hypoglycemia
- R = Reduce glucose variability

(ศุภกมล รุ่งเรืองศิริบุญญา, 2554. Critical care medicine: Make it easy)

Set the Right Target

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 MARCH 26, 2009 VOL. 360 NO. 12

Intensive versus Conventional Glucose Control in Critically Ill Patients
The NICE-SUGAR Study Investigators*

METHODS
Within 24 hours after admission to an intensive care unit (ICU), adults who were randomly assigned to undergo either intensive glucose control, with a target blood glucose range of 81 to 180 mg per deciliter (4.5 to 6.0 mmol per liter), or conventional glucose control, with a target of 180 mg or less per deciliter (10.0 mmol or less per liter). We defined the primary end point as death from any cause within 90 days after randomization.

RESULTS
Of the 6104 patients who underwent randomization, 3054 were assigned to undergo intensive control and 3050 to undergo conventional control; data with regard to the primary outcome are not available for 2010 and 2013 patients, respectively. The two groups had similar characteristics at baseline. A total of 829 patients (27.3%) in the intensive-control group and 793 (26.0%) in the conventional-control group died; odds ratio for intensive control, 1.18 (95% confidence interval, 1.02 to 1.36; P=0.03). The treatment effect did not differ significantly between operative (surgical) patients and nonoperative (medical) patients (odds ratio for death in the intensive-control group, 1.31 and 1.07, respectively; P=0.10). Severe hypoglycemia (blood glucose level, ≤40 mg per deciliter [2.2 mmol per liter]) was reported in 206 of 3016 patients (6.8%) in the intensive-control group and 15 of 3014 (0.5%) in the conventional-control group (P<0.001). There was no significant difference between the two treatment groups in the median number of days in the ICU (P=0.84) or hos-

Set the Right Target

	Insulin SIRT + MICTU study	NIH-BDQAR
Patients (N)	2748	6,094
Setting	2-1 center	42 centers
Patients sample (% of admissions)	95% (SIRT) 60% (MICTU)	15%
Metabolic targets		
Intensive group target	180-210 mg/dL (6.1-11.4 mmol/L)	144-180 mg/dL (8-10 mmol/L)
Intervention group target	80-110 mg/dL 4.4-6.1 mmol/L	0-100 mg/dL 0-5.6 mmol/L
Blood sampling site	Primarily arterial line	Arterial/venous/capillary
Glucose measurement device	Blood gas analyzer (SIRT) Blood glucose meter (MICTU)	Not standardized, not recorded, all types allowed
Insulin infusion	Continuous via central line by syringe pump	Continuous + bolus via all routes, no standardization of infusion systems
None treatment	Guideline = intensive decision making	For "H-H" algorithm
Medication strategy	Early parenteral nutrition	Late parenteral nutrition
Mean caloric intake in ICU	100 kcal/day	800 kcal/day
Blood glucose control performance		
Glucose target reached	70%	<50%
Overlap between study groups	<10%	>50%
Outcomes		
Hypoglycemia	x 9	x 13
Mortality	Reduced organ failure and infections	No effect
Morbidity	Lowered by 40-50%	Increased by 40-50%

Dieter Mesotten, Greet Van den Berghe; Curr Diab Rep (2012) 12:101-107

Set the Right Target

- สรุป ในปัจจุบันผู้เชี่ยวชาญส่วนใหญ่แนะนำให้ควบคุมในระดับปานกลาง คือ ประมาณ 140-180 mg/dl

Underlying causes

- ค้นหาและแก้ไขสาเหตุที่ทำให้เกิด SIH ควบคู่กับการควบคุมระดับน้ำตาลในเลือด

Glucose monitoring

	Capillary Glucose	Plasma Glucose
Specimens	Capillary/Whole blood จากปลายนิ้ว	Plasma จาก Venous blood
ระยะเวลาที่ใช้ตรวจ	< 1-2 นาที	1/2-1 ชั่วโมง
ความแม่นยำ	Overestimate 20-70mg/dl	แม่นยำ มาตรฐาน
ราคา	ราคาถูก	แพงกว่า
ความสะดวก	ง่าย สะดวก เจ็บน้อย	ยุ่งยาก เจ็บกว่า
ข้อจำกัด	Shock or poor tissue perfusion	Hemolysis อาจอ่านค่าผิดพลาด

Glucose monitoring

- Capillary blood samples are unreliable in the ICU and should never be used.
- New technology :
Continuous real time glucose sensor

Guidelines Suggest Blood Glucose Testing for All Inpatients

- All patients should undergo laboratory blood glucose testing on admission if $>140\text{mg/dl}$ should testing of Hb. A1c
- For noncritical illness, antidiabetic treatment should be reevaluated when glucose $<100\text{mg/dl}$ and should be modified if glucose levels $<70\text{mg/dl}$

Laurie Barclay. J Clin Endocrin Metabol. 2012;97:16-38

Guidelines Suggest Blood Glucose Testing for All Inpatients

- Glycemic target should be modified.
- Patients with diabetes who receive insulin at home should receive a schedule regimen of subcutaneous insulin while they are hospitalized.
- To prevent perioperative hyperglycemia, all type 1 DM and most type 2 DM should treat with intravenous continuous insulin infusion.

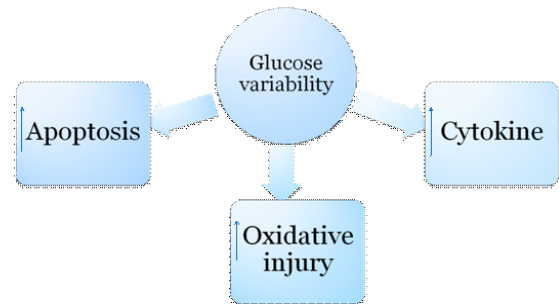
Guidelines Suggest Blood Glucose Testing for All Inpatients

- All patients with blood glucose $>140\text{mg/dl}$ on admission, all patients receiving enteral or parenteral nutrition, corticosteroid should be monitored glucose testing.
- At least 1-2 hours before intravenous continuous insulin infusion is discontinued all DM patients should be transitioned to schedule subcutaneous insulin therapy.

Avoid hypoglycemia

- ให้สารอาหารและพลังงานให้เพียงพอ
- Protocols สำหรับผู้ป่วย

Reduce glucose variability



Reduce glucose variability

- Continuous intravenous insulin administration through a deep venous catheter using a dedicated lumen and accurate syringe pumps avoids undetectable fluctuations in insulin administration.
- ควบคุมระดับน้ำตาลในเลือดให้เป็นไปตามค่าเป้าหมายที่เหมาะสมและมี glucose variability ต่ำ

References

1. คูสิค สทาวร อนามัย วัฒนธรรมและ เอกรินทร์ ภูมิพิเชฐ, 2554. Critical Care Medicine: Make it east.
2. Yehuda Handelsman ,et al. 2011. American Association of Clinical Endocrinologist Medical Guidelines for Clinical Practice for Developing a Diabetes Mellitus Comprehensive Care Plan; Endocrine Practice vol. 17(sopplement2) March/April 2011.
3. The NICE-SUGAR Study Investigators*, 2009 Intensive versus Conventional Glucose Control in Critically Ill Patients. The New England Journal of Medicin, vol 360 No. 13.

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4. Dieter Mesotten & Greet Van den Berghe. Glycemic Targets and Approaches to Management of the Patient with Critical Illness. *Curr Diab Rep* (2012) 12:101–107.
5. Laurie Barclay. Guidelines Suggest Blood Glucose Testing for All Inpatients. *Journal of Clinical Endocrinology and Metabolism*. 2012;97:16-38.

Thank you for your attention

