

Fluid Management in AKI: Squeeze and Diuresis !

Rinaldo Bellomo
Austin Health
Melbourne

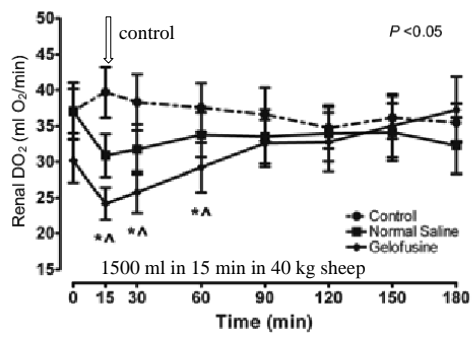
Oliguria and AKI in ICU

- Very common.
- If oliguria is short-lived, the typical response is observation (but not always – see below).
- If sustained, two responses are typically applied
- Fill (fluid administration) hoping that urine will “spill” ...or
- **Squeeze** (increase BP with vasoactive drugs) and **diuresis** (start and sustain diuresis with loop diuretic)

Fill and Spill is dangerous and futile

- In the vast majority of ICU patients there is no “fluid depletion”
- More fluid= No difference to renal blood flow
- More fluid =Minor short-lived changes in urine output
- More fluid =Increased risk of dangerous fluid overload
- Yet “fill & spill” is very common

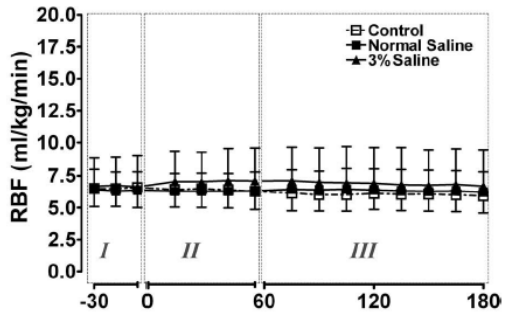
Physiological folly of filling: effect of fluids on renal DO₂



Anaesth Intensive Care 2007; 35: 924-931

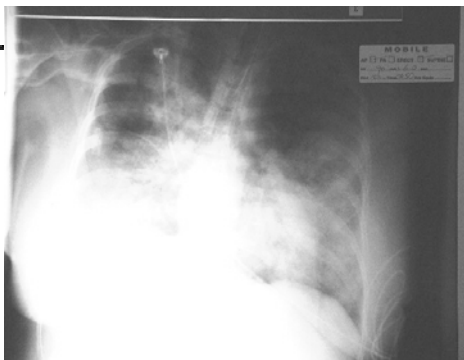
Intensive Care Med 2006; 32: 1238-1242

Fill and Spill: Physiological futility

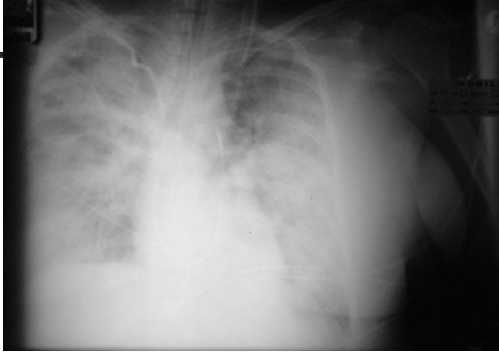


Anesth Analg 2007; 105: 141-7

Oliguric/AKI patient with pneumonia



After fill and spill (into the lungs!)

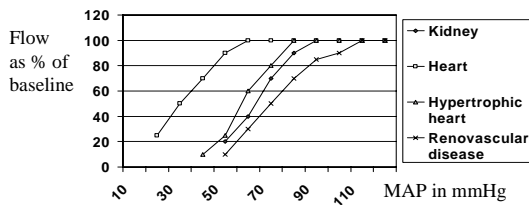


Why we need to squeeze

- Almost all ICU patients are fluid replete
- Almost all are **relatively hypotensive**
- The typical MAP in a 60 year old man is >100 mmHg !! My MAP is 90 mmHg
- Renal blood flow is pressure dependent at low MAP
- Restoring blood pressure closer to normal may improve renal blood flow and diuresis

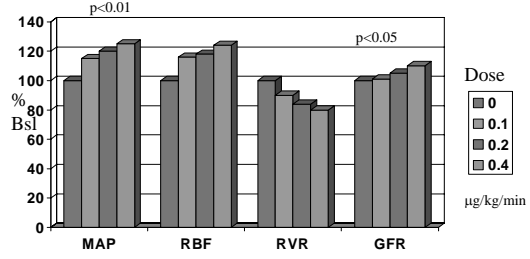
Perfusion Pressure and Organ Flow

$$RPP = MAP - \text{Tissue pressure}$$



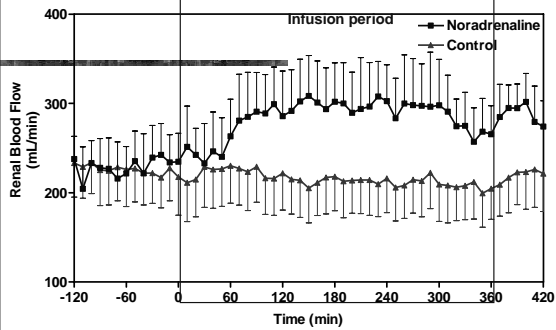
Vasopressors are logical if CO adequate and MAP <70 mmHg
Fluids = tissue edema = tissue pressure = less RPP

IV Noradrenaline (norepi) and the kidney



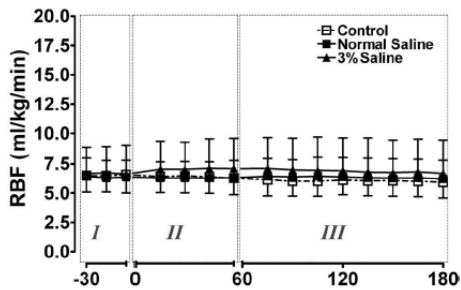
Anderson W. et al. J Physiol 1981

In NORMAL sheep



Chest 2004; 125: 2260-2267

Just to remind you: compare to fill and spill.... in normal sheep



Why we also need to diurese

- Sustained oliguria leads to fluid overload due to obligatory fluid intake in ICU
- Fluid, acid-base, potassium management is much easier if urine output is maintained
- Loop diuretics have useful effects on renal hemodynamics

Possible beneficial effects of loop diuretics

- **Renal Vasodilatation** (Direct vasodilatation, Inhibition of renal prostaglandin dehydrogenase; Blockade of TGF-induced vasoconstriction; Blockade of obstruction effect)
- **Increased tubular flow** (Decreased tubular obstruction by casts; Less back-leak; Decreased back pressure with effect on GFR)

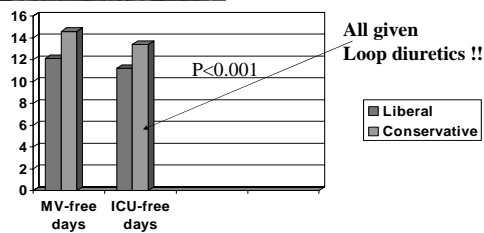
Oliguria/AKI: A Real ICU doctor's approach

- **Restore MAP with noradrenaline (norepinephrine)**
- **Make sure CO is adequate**
- **All simultaneous and rapid (minutes)**
- **Administer furosemide infusion**
- **Maintain diuresis at between 1-2 ml/kg/hr**
- **Administer potassium and magnesium as needed**

The "FACCT"s

- **NEJM 2006; 354: 1-12**
- Comparison of two fluid-management strategies in acute lung injury
- NB: Pneumonia + sepsis >80% of patients
- 503 = conservative strategy
- 497 = liberal strategy

Liberal vs. conservative fluid use



NB: need for RRT 2.8 vs. 1.9% ($p=0.06$)
Mortality 28.4 vs. 25.5%.

Brandstrup's RCT of fluid therapy after abdominal surgery (n=172): restrictive vs. liberal

- Day of surgery fluids:
- Liberal =5,388 vs. Restrictive = 2,740 ml
- Next day: 1500 vs. 500 ml
- Body weight greater in standard care patients for each day for first 6 days
- Complications in **44 vs. 28 patients ($p=0.013$)**
- Increase in body weight correlated with complications

Outcome....

- NNT
- to avoid a complication: 4
- to avoid a major complication: 7
- to avoid a tissue healing complication: 7
- to avoid cardiopulmonary complications: 6
- Standard care : 4 deaths vs. 0
- ARF: 1 case only in standard care group

The Physiological Folly of (excessive) Fluid Filling

- Fluids are bad after surgery
- Fluids are bad in ARDS
- They are physiologically futile in oliguria
- After the first couple of hours, they are physiologically irrational in most ICU patients

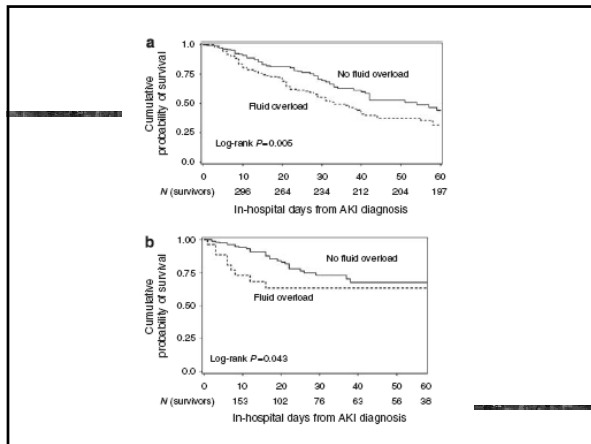
original article

<http://www.kidney-international.org>
© 2009 International Society of Nephrology

Fluid accumulation, survival and recovery of kidney function in critically ill patients with acute kidney injury

Josée Bouchard¹, Sharon B. Sorokko¹, Glenn M. Chertow², Jonathan Himmelfarb³, T. Alp Ikizler⁴, Emil P. Paganini⁵ and Ravindra L. Mehta¹, Program to Improve Care in Acute Renal Disease (PICARD) Study Group

¹Division of Nephrology and Hypertension, Department of Medicine, University of California San Diego, San Diego, California, USA; ²Division of Nephrology, Department of Medicine, Stanford University School of Medicine, Palo Alto, California, USA; ³Division of Nephrology, Department of Medicine, University of Washington, Seattle, Washington, USA; ⁴Division of Nephrology, Department of Medicine, Vanderbilt University, Nashville, Tennessee, USA and ⁵Division of Nephrology, Department of Medicine, Cleveland Clinic Foundation, Cleveland, Ohio, USA



Conclusions

- Fluids can have a high physiological price
- Fluids do not correct vasodilatation
- Fluids do not increase renal O₂ delivery
- They do not increase perfusion pressure
- You can get rid of vasopressor effects in minutes but getting fluid out is not that easy
- Believe my opponent: fluids kill !!
- **Squeeze and diurese !!**

If you fill, it will spill...but into the lungs...and then you will have...

- **American**
- **Respiratory**
- **Distress**
- **Syndrome**

Do not follow the American patho-physiological approach: ...do not fill.....



**and.....spill.....the American way..
Just say "no"**