DO WE NEED STDKT/V?
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INTRODUCTION

Natural as well as artificial kidney blood cleansing is defined and estimated in terms of clearance. Clearance is the amount of blood volume cleared from a specific solute. Clearance is measured as the relation of the eliminated amount of one solute versus its blood concentration within a defined period of time (time average concentration TAC). In stable kidney function the eliminated amount corresponds to generation rate of the solute (G):   **K = G/TAC** (ml/min)

Kt/V is generally accepted as a measure of dialysis dose with **K** (urea clearance) and **V** (urea distribution volume). Urea (MW 60) is an easy to measure, scarcely toxic metabolic end product indicating clearance of low molecular weight uremic toxins as well as protein metabolic rate.

Kt/V can be estimated by formal urea kinetics or short approximation formulae (e.g Daugirdas formula) which have been derived from formal urea kinetics. Formal urea kinetics can be calculated considering one dialysis cycle (time from beginning of one dialysis session up to the beginning of the following dialysis session) (Gotch-model) or one weekly cycle (time from beginning of one dialysis session up to the beginning of the session one week later) (Stiller&Mann-model). Whereas the Stiller&Mann-model (**ST&M**) can be applied in any frequency of dialysis sessions/week, the Gotch-model only is valid in 3 times dialysis sessions/week.

According to guidelines adequate dose of 3 times/week hemodialysis therapy should fulfill the condition of Kt/V > 1,2 dimensionless units.

As a new measure of Kt/V for hemodialysis sessions which deviate from 3 times/week stdKt/V has been proposed with normal values > 2,0 units. This implicates also for 3/week dialysis sessions new normal values of Kt/V instead of > 1,2 .

• The question is: Do we really need stdKt/V as a new measure of dialysis dose?

METHODS

A group of 6 maintenance hemodialysis patients **(V)** have been dialyzed 3x4hrs/ week during one week and 6 x2 hrs/week during another week using the same dialyzer, the same blood flow **(K)** and the same total time **(t)** of therapy during one week.

Kt/V has been calculated using formal urea kinetics (**ST&M**, two compartment model), Daugirdas formula (single compartment, second generation (1993)) and 2 approximation formulae for stdKt/V (Leypoldt, FHN).

• **Formal urea kinetic modeling**

Gotch-model: Based on a **two days dialysis cycle** including one dialysis session and the interdialytic interval thereafter. Data input: Pre- (C_o) post- (C_1) dialysis and pre-next dialysis session (C_2) urea concentration. Pre/post dialysis body weight. Length of dialysis session and inter-dialytic time interval. In order to be representative for one week data should be taken from mid-week dialysis session.

ST&M-model: Based on a **weekly cycle** of urea metabolism. General assumption: Dialysis sessions have the same length, same dialyzer as well as blood flow. Data input: Pre- (C_o) post- (C_1) dialysis urea concentration and body weight of any dialysis session/week. Days of dialysis sessions during one week (Mo-Tue-Wed-Thu-Fri-Sa). Length of dialysis session. V as fat free body mass or Watson formula. G and K are modulated in an iterative way until they fit with the measured data (C_o) and (C_1). The model is independent from the number of dialysis treatments/week and the inter-dialytic time interval.

• **Approximation formulae**

$$\text{Kt/V-Daug: } \frac{Kt}{V} = -\ln(R - 0,008 \times t) + (4 - 3,5 \times R) \times 0,55 \times \frac{UF}{V}$$

$$\text{stdKt/V-Ley: } \frac{10080 \times \frac{1 - e^{-eKt/V}}{t}}{\frac{1 - e^{-eKt/V}}{sp^{Kt/V}} + \frac{10080}{N \times t} - 1}$$

equation using Gotch equations based on Co;
$_{sp}$Kt/V : pre-&post urea conc.
N: Number of treatments per week

$$\text{stdKt/V-FHN: } \frac{\text{stdKt/V (Ley)}}{1 - \left(\frac{0,74}{N} \times \frac{UF_w}{V}\right)} + \left(K_{ru} \times \left(\frac{0,974}{(sp^{Kt/V} + 1,62)} + 0,4\right) \times \frac{10080}{V}\right)$$

$_{sp}$**Kt/V**: pre-&post conc., two-BUN method (Depner)
**N**: Number of treatments per week, **UF_w**: Weekly ultrafiltration (l),
stdKt/V (Ley): simplified stdK/by Leypoldt; **K_{ru}**: Residual kidney urea clearance (ml/min)

## RESULTS

COMPARISON OF Kt/V BY UKM AND APPROX. FORMULAE

| N=6	3/WK	3/WK	6/WK	3/WK	6/WK	3/WK	6/WK
	Kt/V Daug	Kt/V ST&M	Kt/V ST&M	stdKt/V Ley	stdKt/V Ley	stdKt/V FHN	stdKt/V FHN
MEAN	1,46	1,44	1,47	2,20	2,84	2,33	2,94
SD	0,24	0,27	0,24	0,17	0,27	0,19	0,28

WEEKLY CYCLE UKM (ST&M)
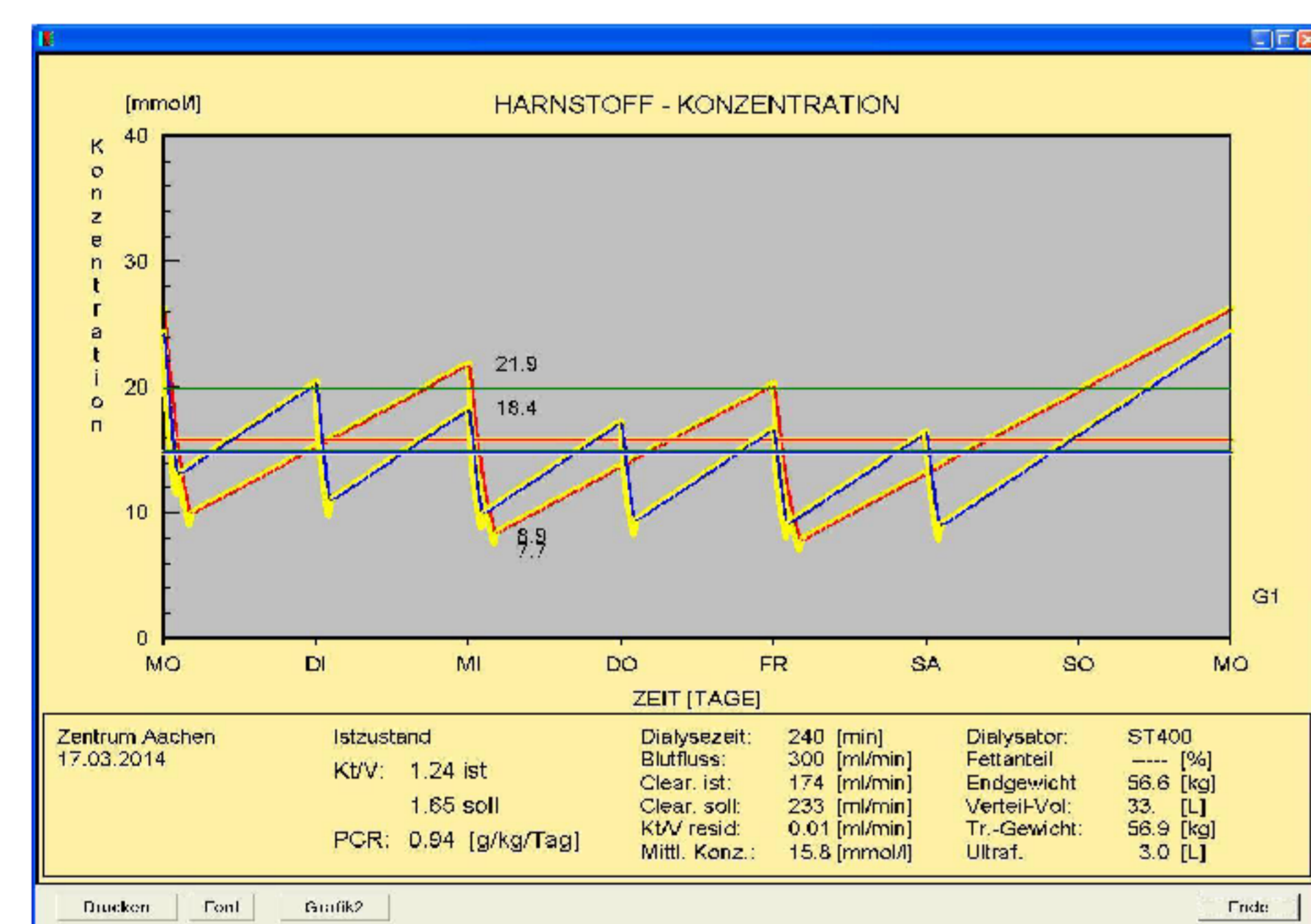
Steady state of one patient during one week
Calculation of KT/V, PCR, G, TAC, delivered clearance (K_{del}) and prescribed clearance (K_{pre})
Any frequency in the weekly cycle model can be applied

CALCULATION OF Kt/V BY DIFFERENT FORMULAE
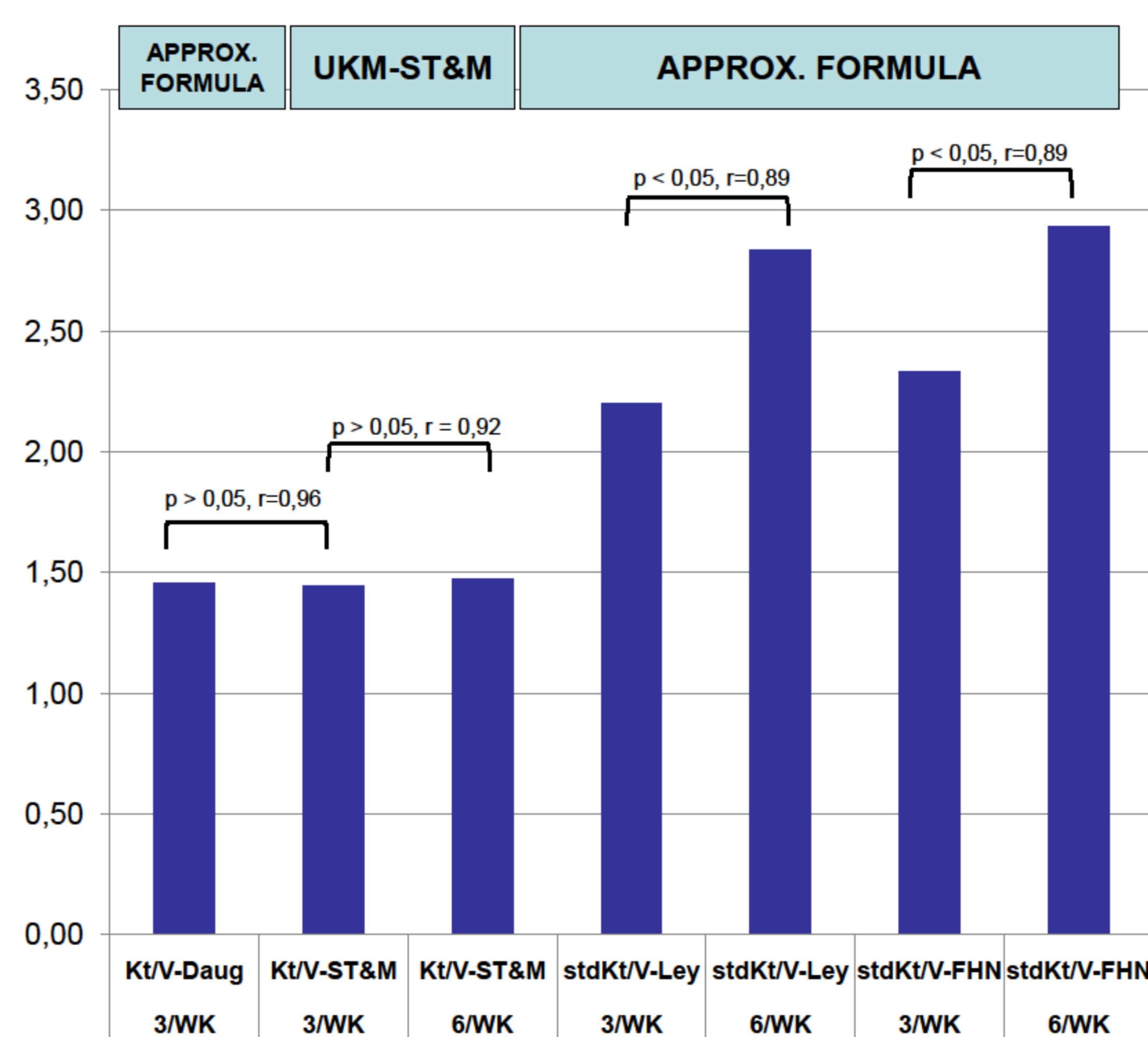
There is no difference in Kt/V in 3x4 hrs dialysis and 6x12 hrs dialysis (same Kt), when calculated using formal urea kinetics on a weekly cycle

WEEKLY UREA CLEARANCES DEPENDING ON MODE OF THERAPY AND MODE OF CALCULATION
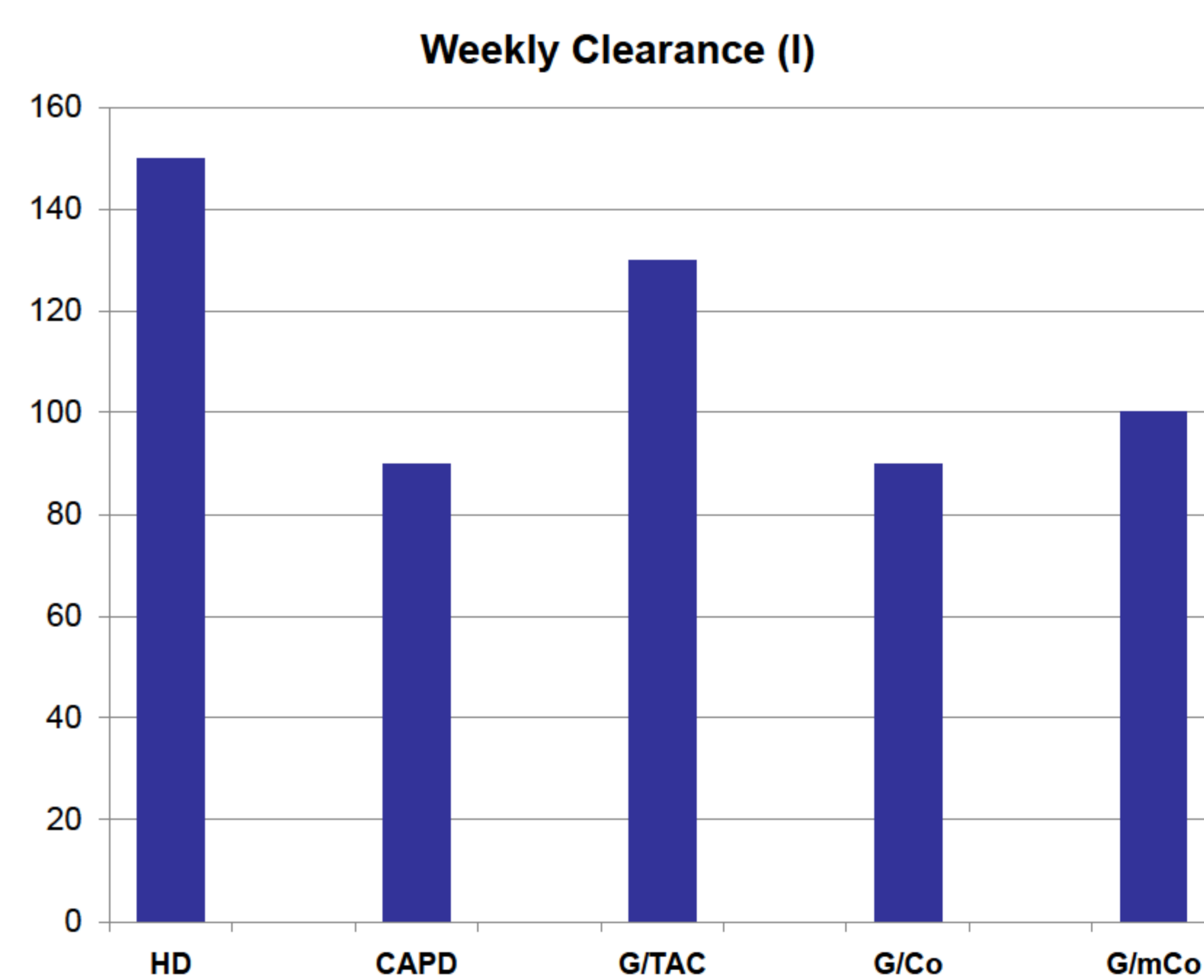
G is estimated from the same set of pre - post urea concentrations of the 6 HD patients

The weekly continuous clearance should be estimated based on the ratio G to the time average concentration (TAC) . G/C_0 or G/mC_0 (stdK-Gotch) matches with the weekly continuous clearance in CAPD .

CONCLUSIONS

• We do not need stdKt/V because Kt (3x4hrs dialysis) does not correspond to Kt in (6x 2hrs dialysis). In stdKt/V the term K does not represent urea clearance any more. Mean peak concentration is not time average concentration.

• In all kinds of hemodialysis therapy urea kinetics should be ascertained using formal urea kinetics on a weekly basis independent from the frequency of dialysis session/week.

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402--MP

M) Dialysis. M1) Extracorporeal dialysis: techniques and adequacy.

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