### Beginning of CAPD Dawn of New Era

Prof Tahir Shafi

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#### First peritoneal dialysis in humans

- George Ganter 1923
- First Peritoneal dialysis in humans, a female with obstructive nephropathy due to CA uterus



Ganter G,. Munch Med Wochschr 70:1478, 1923



#### CIPD Late 1960s and early 70s

- Intermittent high volume PD-Dialysate, flow rate 2-4 liters/hour, 30 to 60 minutes dwell time, for 12 - 14 hours 3 to 4 times a week, 50-60 hours a week
- Failure to thrive
- 810 patients < 3 % patients of RRT on PD, manual or use of cyclers/ RIO machine in 1975.

#### CIPD in USA





TS Boen Belding Scribner Wayne Quinton Albert Babb

ge:

#### North West Center



#### Popowich Monsrief collaboration



#### April 1975



sville

hemodialysis with repeated episodes of access failure. All access sites exhausted. No possibility of hemodialysis

### June 1975





#### Research meeting goes on







#### • Robert Popovich's idea of long dwell peritoneal dialysis

#### Kinetics of long dwell PD



Exchange of 10 liters of fluid with long dwell will remove 7000 mg of BUN daily production of nitrogen of 7000 mg

#### Start of prolonged dwell PD

- This idea of peritoneal dialysis with ten liter fluid and prolonged dwell time was accepted as they did not have enough peritoneal dialysis fluid available
- Tenchkoff catheter was inserted surgically
- Prolonged dwell continuous peritoneal dialysis was started with 2 liter glass bottles and standard peritoneal dialysis administration "Y" set

## Portable/wearable equilibrium peritoneal dialysis technique



### Portable/wearable equilibrium dialysis

Peter Pilcher was trained to do the exchanges by himself once Moncrief had been able to determine that the solution could be left in the peritoneum overnight without compromise. The patient was dialyzed with this system for over two months and was then had kidhey transplant. American Society of Artificial Internal Organs Conference in 1976

Popovich RP, Moncrief JW, Decherd JF, et al.

The definition of a novel portable/wearable equilibrium dialysis

technique. (Abstract)

Trans Am Soc Artif Intern Organs 1976; 5: 64.

#### National Institute of Health Contractors Meeting January 1977



### National Institute of Health Contractors Meeting January 1977



### National Institute of Health Contractors Meeting January 1977

Monsrief and Popowich requested a grant from the National Institutes of Health to continue dialyzing patients with prolonged dwell because it was not covered by Medicare. They did not get the grant but got collaboration of Dr, Karl Nolph.

Karl Nolph at the University of Missouri, joined Monsrief and Popowich to continue to evaluate the clinical use this type of dialysis and renamed the procedure as continuous ambulatory peritoneal dialysis CAPD.

Nolph had an interest in the kinetics and transport of the peritoneum that had been stimulated by the work of Boen and his collaboration with Popovich on peritoneal dialysis. Nolph's group began to treat patients with CAPD as early as January 1977. They were able to publish their results, which included the Moncrief experience in 1978

#### Collaboration of Monsrief and Nolph -CAPD

 CAPD was the name used in the abstract submitted to the American Society of Nephrology (ASN) by Popovich, Moncrief, and Nolph later that year, and this abstract was accepted for presentation at the November 1977 ASN.

#### Nolf's early experience

- Nolph's group began to treat patients with CAPD as early as January 1977.
- Results published including Moncrief experience in 1978. The results were promising but the high incidence of peritonitis continued to be a problem.

#### Knolf's early exprience

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ORIGINAL RESEARCH | 1 APRIL 1978

### **Continuous Ambulatory Peritoneal Dialysis**

ROBERT P. POPOVICH, Ph.D.; JACK W. MONCRIEF, M.D.; KARL D. NOLPH, M.D., F.A.C.P.; AHAD J. GHODS, M.D.; ZBYLUT J. TWARDOWSKI, M.D.; W. K. PYLE

#### 1977 – Toronto experience



Very large chronic peritoneal dialysis



### Oreopoulos's first CAPD patient

- Return of Jack Rubin from Missouri after training with Knolf to Toronto and
- Oreopoulos was briefed of the results of the CAPD program at the university of Missouri.ie therapeutic benefits of CAPD and risks of peritonitis related to the use of the bottle method.
- Oreopoulos was very skeptical of the clinical application of CAPD.
- June1977. One of Oreopoulos 's patients, who had been trained on RIO peritoneal dialysis, was re-admitted into the hospital to be trained on the cycler because she was not doing very well on RIO peritoneal dialysis. The patient had an unfortunate fall in the hospital and the staff decided to perform manual peritoneal dialysis on her.
- Canada had begun using the two liter collapsible container for peritoneal solution

#### Oreopoulos's First CAPD Patient. 27-9-1977

- Oreopoulos decided to try CAPD.
- Standard "Y" set with the two liter containers and began to perform the standard CAPD procedure. Empty bag was used to collect the spent solution and the procedure was repeated every four hours.
- The patient's condition improved so dramatically the patient was able to ambulate safely.
- Oreopoulos had over seventy patients on peritoneal dialysis. He was able to convert the IPD patients quite rapidly to CAPD and he could evaluate the results on a broad based patient population very quickly.

#### Toronto Western Technique CAPD 27 -9-1977



#### First CAPD in Canada

• The order by Dr. Oreopoulos describing the steps of the Toronto Western Hospital Technique for CAPD.

22/9/77 INCREASE CHARCOAL TO 10 GMS. Q1D 26/9/77 1200 TOMORROW A.M., LEAVE 2000 CC 1.5% PERITONEAL IN USING UBING END OF DRAIN CHECK OUT OD. FURTHER NOTICE. VERBAL ORDER BY D. OREOPOULOS/ S. IZATT

#### Conversion of CIPD patients to CAPD

- Impressed with the results of first patient a deal was offered to more than 50 CIPD patients.
- Deal was to try CAPD for one week, if unsatisfied they could go back to cycler. all of these patients preferred to stay on CAPD

#### ASN Annual Meeting November 1977 – Washington DC

- "Road to Freedom"
- Documentary film about CAPD shown by Oreopoulos
- I had the opportunity to attend that conference and started CAPD program in Charleston West Virginia where we had large number of home PD patients .

#### Annual Contractors' Conference in Bethesda, Maryland- January 1978

- Presentation of steps of this technique at the invitation of Dr. Ben Burton, then director of the Artificial Kidney and Chronic Uremia Program of the NIH.
- Drs. Popovich, Moncrief, and Karl Nolph, who were most impressed with the technique.

Presentation at Annual Meeting of the American Society for Artificial Organs

• Presentation of the results of this new technique under the title "A simple and safe technique for CAPD", by Dr. Oreopoulos to a larger number of physicians at the Annual Meeting of the American Society for Artificial Organs later in 1978.

#### First grant from NIH for CAPD

- Dr. Ben Burton, then director of the Artificial Kidney and Chronic Uremia Program of the NIH invited Dr Oreopoulos, at Annual Contractors' Conference NIH Bethesda January 1978
- The steps of this technique were first presented
- Dr. Oreopoulos got 3 years contract.

# Approval of the plastic bags in the United States

- Because of the outstanding results obtained in Toronto, Dr. Burton tried to expedite the introduction of PD dialysate in plastic bags in the United States.
- Early on, Baxter had submitted an application to the Food and Drug Administration (FDA) for approval of PD dialysis solution in plastic bags, but this was not actively pursued.
- Citing Oreopoulos findings, and under considerable pressure from nephrology teams including those in Austin (Texas; Columbia (Mo.), and at the NIH, the dialysate bags were approved for use in the United States by the end of 1978.

#### FDA approves plastic bags for dialysis in USA

of smallpox	FDA okays plastic bags
year and a	for home dialysis
that natu-	BETHESDA, MD,-A threefold drop in
ces of the	the incidence of peritonitis in patients
	with chronic kidney failure treated by
the future	continuous ambulatory peritoneal dial-
James H.	ysis can be expected now that FDA has
re working	approved plastic containers for dialy-
looks like	sate, says Dr. Jack W. Moncrief of the
with the	Austin Diagnostic Clinic in Texas, At
in West	the same time, he predicts the approval
mallpox."	is expected to increase markedly the
Smallpox	number of patients who will be
Center for	dialyzed by this method.
ts that his	The peritoneal-infection rate is only
epox virus	one case for every eight patient-
d rodents.	months in Canada, where plastic
ld in Zaire	containers have been available for
i smallpox,	several years (MWN, Feb. 6, '78, p. 7).
re a wild	By contrast, Dr. Moncrief points out
x?"	that the peritonitis rate in the U.S.,
t of small-	where glass bottles are used, is about
rus stocks	four times as high. The glass bottles
s. Toward	have to be disconnected after each
two labo-	exchange, and this results in a higher
ly" with a	infection rate.
n request	A recent informal poll indicated that
d smallpox	if plastic bags could be used for dialy-
	sate, at least 50 centers would consider
can Type	switching some of their dialysis pa-
company,	tients to the ambulatory procedure.

## Approval of the Plastic Bags in the United States October 1978

 Because of the outstanding results obtained in Toronto, Dr. Burton of NIH and Considerable pressure from nephrology teams including those in Austin (Texas; Columbia (Mo.), and at the NIH,

Karl Nolph and his PD team with first patient to use bag This patient was sent to Nolph from New York for training on CAPD with glass bottles but plastic bags just became available



#### First CAPD with plastic bags in USA

 Dr. Robert Longnecker from New York City had sent one of his hemodialysis patients with marked cardiovascular instability to the University of Missouri for CAPD training. The patient returned to New York on CAPD, but wanted to return for training with solutions in bags once they became available. He arrived in Columbia following FDA approval of bags on almost the same day we received our first supply of bags, which had been stored in a Baxter Healthcare warehouse in St. Louis pending FDA approval

#### FDA approves plastic bags for dialysis in USA





• One in 3 or 4 patient months with glass bottles to one in 11/12 patient months with Toronto Western general technique

#### Early publications

- Popovich RP, Moncrief JW, Nolph KD. Continuous ambulatory peritoneal dialysis. Ann Intern Med. 1978;88:449. 16.
- Popovich RP, Moncrief JW, Decherd JF, Bomar JB, Pyle WK. The definition of a novel portable/ wearable equilibrium dialysis technique (ASAIO abstract). Trans Am Soc Artif Intern Organs. 1976;5:64. 17.
- Oreopoulos DG, Robson M, Izatt S, et al. A simple and safe technique for continuous ambulatory peritoneal dialysis (CAPD). Trans Am Soc Artif Intern Organs. 1978;34:484-487

#### Media coverage

- Publications in Time Magazine and National Enquirer: In December of 1978, Time magazine ran a story on CAPD that generated worldwide interest in this new dialysis therapy.
- Publications in Time Magazine and National Enquirer: In December of 1978, Time magazine ran a story on CAPD that generated worldwide interest in this new dialysis therapy.

### Media Coverage





Figure 1 - CAPD technique as described in a cartoon in Time magazine, December 18, 1978, page 82.



#### Hmerican Journal of Nursing

#### AT POLICE 1.1.1.1

Solution drains out + hen hag is

keened after "dwell time."

#### Continuous Ambulatory Peritomeal Diallysis

more than 20 extentes.

#### By Alive J. Sounds

of six bourdeness and obtainey peritowned dissipant ICAPPC the proto-14 hours a day, seven days a work. This inclusion, developed by Jack forward M.D., and Robert Poporach Ph.D., at the Anathe Diagnosthe Classe in Assotia, Taxan, gives

partients with chrunk; senal failure from its peach, lowers it to the or Department and independence. Four contrarges of french dialyand applications are independent starts day.

With more of these exchanges the bacastered with an unformed welthing cavity for few hours, and the fourth ance mouths eversight (right to ten lours! The sound exchange inner are 7 A.M., 12 sports, 5 F.M., and O P.M. bet millents may adjust the tions depending on individual Aubits

The disjoint solution is now cycle takes about 30 minutes. Then liable in two-liter plantic bugs, ich have been approved by the and and Drog Administration soundy, the solution was suped in hottles and the procedure the complete connection and muertine of the tubing at the

Now, the patient's catheter is exted to the tubieg at all times. same take serves to fill the and cavity and to drain it. re change the tubing once a , using sterile technique, At the putient, using aseptic pre connects a new two-liter dialysis solution to the tubor each exchange It takes mately six to few minutes to peritonesl cavity. When It is patient changes the tubing. he hay wraps the tubling

CHARLES & N. & & BOARD PROPERTY. looy bealth ence program. Texas record of Health in Austin the is othing with the Montrief Popula oth Restitute on a sast question t braching state approved dialy

new Internal of Normary/Ausput 2079.

around the log, and places the Arr mercul activitize while the dua-pointh. This periods has as which are substant to place of LS parenet solution is

roppe

Diantal LS percent association in informate, or it east he stropped to the and (applied by Traveroid Laborawaist or thigh Litathir pouches are noricy) for even of the anchorages and also available flut attack to a helt. Disseal 4.25 persent, a hypertonic At the staf of the "doell. activities, is used for the other two time"-time during which the saleexchanges. The hypertensic solution tion semality in the covidy-face prevents excessive weight gain, and hoose in the day line or law at night. petients have more freedom in the patient spannes the plastic long closecing their detailing fluids.

peritonnal cavity anally taken no altes for hemodialysis, and the pa-After the patient his emptied tient's professed mode of treatment. the peritonnal awaity, again using In the Texas and Colombia, Missonaneptic suchsique, he disconnects the bag of used solution, connects a new heg, and fills the peritoneal eavily again. The cetire process, from the beginning of drainage of

stage renal disease. In Turninto, where disbuis polation has been the volution to the end of the filling available is plastic higs for several years, Dissitrios Geopoulos, M.D., the person is free to go about his or has transferred many hemodialysis



The server colored real in these polasitic last least backets to the last 5.0 mg, protect. The servers brought priority and the servers scored from 3.3 in 3.7 mg present, and for many patient, the use of other the server patient. easis "southing-free." Most of these perieses trandenest from terplumphered heading speeds has been president Sub-old to CAPD experter a passed for some independence and in he reduced or discontinued 11 antrol of their lives.

Mast patients an CAPD have infle or no dutary restriction. Be-Originally, Monariel and Pagan on another state based of the came of postein and potantion screps area altruges level of 70 stg. hours in the dislysate, they are percent as an acceptable stands advised to increase their protein mits blood value. However, must intails to I Get./kg. of htdy weight sotimuts, after there to sis searchs an or some, and potassions intake to 50 CAPD, have blood ones allruges mily /day. The potention require levals herears 40 and 60 mg, permost subcardy can be satisfied by. using potentions abducide fault milecant, and maintain these fevels as long as they excellence their four strate) an prepared foods. exchanges per day. Creatinise lev-

The use of Discoul 4.25 perwishers been substained between & cent solution for two exchanges per day achieves patients of the need to The patients have not needed matrice floats. However, if science in add potaulum to their dialysis or weight gain nerson, patients are instructed to limit fluids until they entation, and have maturated potandom levels of 3.5 to 5 mEq/1. seture to their ideal weight. Occasionally, they have needed an oral potaminan supplement[1].

A marked advantage of CAPD is its comparatively low cost. The Despite the estensive ions of price of in-center hemodialysis is protein with peritorical dialysis, panow approaching \$25,000 per patients have maintained low to tiest per year. The cost of CAPD slightly below some limited abouid not succed \$5,500 to min levels, ranging between 3.0 and \$10,000, a minimum arving of

625,000 per patient per year. The main problem encounternel with CAPD has been recorring peritonicit. In the Texas and Missouri centers, the incidence of peritositis with the use of dialysis solution in bottles was one in every 10 patient weeks, while Oceopculos reported one case of peritonitis in every 45 patient weeks using diabysis solution in plantic bags.

Now, since the distysis spintion is available in two-liter bags in the United States the incidence of been reduced to one in every 35 nections and disconnections required with the use of bottles was the principal contributing factor to the high incidence of peritonitis.

Recently, however, some difficultics have been encountered with the connectors excently in use. These problems may have caused approximately 90 percent of the

correctly permanents since the distribution authorized foregoing the stability in planter bags in Genetics 2021. Then were productory does to the way the prosters. for nor in CAPD. However, the Missensi and Texas restors are save working with Tracwind Laboration rise ha develop mittable supportant

for CAPD rolling. As the desirance introng in refound, it is anticipated that peritons

Marmal Rised Chemistry Values-1550 Cm.15 6.5.50.5 mg/ml Monda \$5.500 mile/1 man 0852 mg./d. -COM 5510 mald kined water Territoria and 07342 2642 09/d. adaute . Waterman, F. E. Closed Interentration of Laboratory Term String 973. 59. 260 253.

the will excert maniely at a people of the patient's failure to follow sampthe technique. The CAPD procedure is simple, but any deviation in technique is potentially damperoon. Therefore, recollution of techmique is essential to remaind pathese's that frequent problems can norms with shortcasts.

Most patients on CAPD describe an increased sense of well-

being, an increase in energy, and improved appetite. Many patients have because more active than they have been in years. The most profound effect,

however, is the ironious that these patients enjoy. They can exchange fluids in a car, a restroom, and in peritonitis at the Texas Center has parks, rather than coping with the inconvenience of seturning to conpatient weeks. It appeared that the place four times a day or being multiple-catheter and tubing con- connected to a marhine several hours a day, several times a work

#### References

- 1. Faperick, R. F., and others Coursesons ander Salary perturned district Ann Innon Med. 83-143 456, Apr. 1978. 2. Mounted, 5. W., and athen: Addressed argues-
- ence with randianan antalatory proposed data in CAPIE. Turks An Sar Anij Incas Co-Acres 24-476-453, 1978.

Annual Impaid of Harport August 2005 1401



Dislysis solution fills the preitoural resulty (left); empty hag and taking are placed in a possels until meded for drainage.

Conti maw, the eriteria for se-Roor, successing the follows and lets hering patients for CAPD have the solution desire. Drainage of the here the graninity of a dodyna center, the availability of access and 12 stg. posteor(1). el Medical centers, most patientes plated as CAPD have now here newly disgoond as having and-

#### Saint Popovich on Mountain Dialysis

This is the way Popwich was portrayed by a nephrologist who was an artist also

Delivering his sermons about CAPD

#### Medicare Reimbursement

- Medicare coverage for PD began about 1 year later.
- Prior to Medicare reimbursement, some high-level officials from the Health Care Finance Administration flew to Columbia, Missouri, from Baltimore to talk with Nolf to gather information as part of their deliberations concerning if and how CAPD should be reimbursed.
- Their plane landed in Columbia on a stormy night and slid off the runway into the mud. They walked to the Columbia Airport terminal through knee-deep mud and attended the meeting with mud from their feet to their knees. In spite of this, they seemed to react favorably to what they learned, and CAPD reimbursement was approved shortly after this trip.

## Umberto Buoncristiani from Perugia Italy visits to Toronto Western Hospital



#### Perugia technique -

After his visit to Toronto Umberto Buoncristiani introduced this technique to cut down peritonitis realizing the source of infection ie site of connection

Y set CAPD system.

- 4 steps
- 1. Drain
- 2. Flush before fill
- 3. Fill
- 4. Fill with disinfectant



#### A new simple connection system 1980



Beoncristiani U, Bianchi P, Cozarry M et al: A new safe simple connection system. Int Nephrol Urol Androl 1: 50-53. 1980

#### Perugia technique -

- Buoncristiani U, Bianchi P, Cozzari M, et al. A new, safe, simple connection system for CAPD. Nephrol Urol Androl. 1980;1:50-53.
- Canadian CAPD Trials Group. Peritonitis in continuous ambulatory peritoneal dialysis (CAPD): a multicenter randomized clinical trial comparing the Y-connector and disinfectant system to standard system. Perit Dial Int. 1989;9:159-163.

#### Perugia technique -

- Perugia technique /Y connection technique/" Flush before you fill" technique
- Infection rate decreased to 1 in 36 months
- Publication of results in Lancet
- Results too good to believe
- 5 years later the technique was accepted in North America after a prospective control trial by Dr Churchil + Oreopoulos

#### Montipellier disconnect system



#### Double Bag System



Bazzato G, Landini S, Coli U, et al. A new technique of continuous ambulatory peritoneal dialysis (CAPD): double-bag system for freedom to the patient and significant reduction of peritonitis. Clin Nephrol 1980; 13: 251–254.

# ANDY (A Non Disconnect Y) Disk and Stay Safe System



### First International Symposium on Peritoneal Dialysis, held in Chapala, Mexico, 25 June 1978.



First International Symposium on Peritoneal Dialysis, held in Chapala, Mexico, 25 June 1978.

## Speakers at the First International Symposium on CAPD, Paris, France, November 1979.



#### Second International Symposium on CAPD, Austin, Texas, May 1980



#### International Symposium on Chronic Peritoneal Dialysis, held in Buenos Aires, Argentina, July 1980



First National CAPD Conference was held in Kansas City, Missouri, February 16 – 19, 1981.

#### More mile stones

- Oreopoulos started a journal titled *Peritoneal Dialysis Bulletin*—which was later changed to *Peritoneal Dialysis*
- CAPD Registry 1980
- International Course on Peritioneral Diatysis Med Viceriza, in the spring of 1982, in Vicenza
- In 1984, the International Society for Peritoneal Dialysis was founded.

#### CIPD before CAPD



#### CAPD patients in Pakistan in 90s



#### CAPD patients in Pakistan in 90s



#### Conclusion

- This review emphasized the contributions of many persons, not only physicians and surgeons but others also, toward the ultimate concept of CAPD.
- It is a story of men and women with new ideas and initiatives, and of the thousands of brave persons who place hopes for survival on all these efforts. (Russel A Palmer)

# Thank You