ITS NOT A 4 LETTER WORD

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SWAN
GANZ
CATH
While German physician Werner Forssmann was still an intern, he theorized the basics of cardiac catheterization, whereby a long, very narrow tube (a catheter) is inserted into a vein at the elbow, then advanced through the blood vessel until it reaches the heart. The catheter, he surmised, could be used to ferry drugs needed for cardiac resuscitation directly into the heart. His superiors dismissed the idea, certain that such an intrusion into the heart’s inner workings would be fatal. So Forssmann tested his idea on himself. He anesthetized his lower arm and opened the antecubital vein in his own elbow, inserted a small metal tube into his bloodstream, and watched on a fluoroscope screen as it progressed up his arm and toward his heart. He then walked down the hall and up two flights of stairs to have an x-ray taken, showing the catheter in his right auricle, near the atrium of his heart. After his audacious experiment Forssmann published a paper on his success, suggesting that this technique would allow measurements of blood pressure inside the heart, and could be used to introduce radiopaque dyes, allowing detailed x-rays of the heart that would expose any abnormalities. When the paper was published, though, he was widely considered a kook, and condemned as foolhardy by his superiors. For self-experimentation, he faced disciplinary actions so severe that he abandoned his cardiology internship and pursued urology instead.
Evolution of Swan Ganz cath

* 1929 Dr. Werner Forsmann did RHC on himself and proved it to be feasible in humans
  * Only floated as far as the RA

* 1956 Drs Forsmann, Andres Cournand and Dickinson Richards won a Nobel prize proving a catheter could be used to assist in the diagnosis of congenital heart disease

* 1965 Dr. Fife constructed self guiding pulmonary artery catheters

* 1970 Drs. Swan and Ganz developed balloon flotation catheters

* 1977 or so… the term “swan” became a verb
  * We swanned the patient

DR JEREMY SWAN & DR WILLIAM GANZ
The Use and Abuse of Swan Ganz Catheters

* As with many new technologies swans were probably overused as it allowed for the hemodynamics to be easily ascertained at the bedside
* Routine invasive monitoring in the ICU or Post MI was eventually shown to be not helpful and was potential complications associated with it

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Escape Trial

Study done in 2005
Done to see if placing a PA catheter improves survival in pts admitted with CHF / volume overload
Adherence to beta blocker use at that time <30%
No indication at that time for aldosterone inhibitors
No CRT available
No Impedance Plethysmography with AICD’s

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Escape Trial

* Inclusion criteria
  * Ace inhibitor for 3 months
  * Diuretics
  * An ER visit or CHF hospitalization in the last year
  * Treatment in the last month w/160mg of lasix or more
  * EF < 30%
  * SBP < 125
  * At least one sign and one sx of congestion

* Pts sick enough to make use of PA cath reasonable but not sick enough so that crossover to use of pa cath likely
Escape Trial

* Exclusion criteria
  * Creatinine > 3.5
  * Prior use of dopamine or dobutamine > 3.5 mcg/kg/min
  * Use of milrinone during index admission
  * No requirements as to which meds to be used but encouraged diuretics and vasodilators
  * Trial ended early due to concerns of adverse events and unlikelihood of achieving a difference in primary endpoint
  * Being alive out of the hospital at the 6 month mark

Escape Trial

* Conclusions
  * Therapy to decrease volume overload during hospitalization for CHF and improvement in sx was no different if PA cath used or not
  * I think the generalization after this trial that swans are of no use has actually done a disservice to the pt population with advanced heart failure and the significant amount of information that is gained by the proper and judicious use of this tool

4 QUADRANTS OF PATIENTS

<table>
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<th>Perfusion</th>
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<th>cold</th>
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<tr>
<td><strong>wet</strong></td>
<td>Needs diuresis</td>
<td>Needs uptitration of meds</td>
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<td></td>
<td>Typical CHF</td>
<td>Poor perfusion</td>
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<td></td>
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<td></td>
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<td><strong>dry</strong></td>
<td>Not CHF</td>
<td>Needs volume repletion</td>
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<td>Advanced CHF</td>
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<td>Patient</td>
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**Indication for Swan Ganz cath**

* Differential diagnosis of Pulmonary Arterial HTN
* Evaluation of patients for OHT and/or VAD
* Evaluation of pts with ESLD for dx of porto pulmonary HTN
* Appropriate treatment of pts with both severe copd and chf and/or pneumonia and chf
* Adjunct to assess volume status In pts with chf and renal failure

**Indications for Swan Ganz Cath**

* Eval of pt with low SVR, low CO, despite low BP
  * ie amyloidosis
* Pseudosepsis syndrome where pts with chf are “overvasodilated”
* Treatment of potentially reversible causes of severe chf
* Treatment of pts with discordant right and left heart failure
* Cardiogenic shock post MI
  * RV Infarct
  * Acute Mitral regurgitation
  * VSD

**EN**

* 36 yo hm with 5 year hx of DCM
* Treated with appropriate chf therapy
* 2 months prior to admission developed worsening sxs with weight gain of 35 pounds,
  * Dyspnea, vomiting, early satiety, orthopnea
* Admitted to outlying hospital with acute exacerbation of CHF
EN

* During his hospitalization his creatinine peaked at 4.5 and a shiley cath was placed for initiation of HD
* This was exchanged for a perm-cath and eventually an AVF was placed in his left forearm
* He was transferred to TGH on dobutamine for evaluation for heart and kidney transplant

EN

* Upon arrival to TGH
* BP 86/60, HR 130
* JVD to angle of jaw sitting up
* Rales in bases
* S3 gallop with 3/6 MR murmur and lat PMI
* Pt arrived on dobutamine 5mcg/kg/min
* CXR- cardiomegaly with interstitial edema
* EKG sinus tachy HR 130, low volts, QRS 122ms

EN

* RHC  RA 22
  * PA 56/26
  * PCWP 28
  * CI 2.2
  * On Dobutamine 5mcg/kg/min
  * ECHO EF 10%, right sided chambers normal
  * Mild mitral regurgitation
  * Mild tricuspid regurgitation with estimated PA pressure of 25 mmhg
EN

* Lasix drip initiated, dobutamine continued
* With this, his CVP fell, PA pressures fell
* Cardiac index increased to 2.8
* AVF taken down
* Patients creatinine normalized
* Pt eventually required OHT
* Remains with normal renal function 3 Y post OHT

OS

* 55 year old AA female seen for evaluation for “burned out mitral regurgitation”
* Pt with severe right heart failure sx to include
  * Marked JVD, ascites, lower ext varicosities and edema
  * Weight gain, fatigue and dyspnea
* Echo revealed huge right side, wide opened TR, EF of 40% with moderate MR

OS

* Right heart cath
* RA 30, RV 80/30 PA 80/30 mean PA 47 pcwp 10
* Cardiac Index 2.1
* Marked transpulmonary gradient of 37
* Work up revealed
  * Chronic thromboembolic disease
* Pt had bilateral thrombectomy with improvement in PA pressures to 40/20 and improvement in cardiac index to 3.2 and marked normalization of her right ventricular size
**JQ**
- 64 year old HM with ICM undergoing eval for OHT
- Class 4 sx with dyspnea at rest
- SBP 86, Na 132, Hgb 9.6, creat 1.5
- RA 6 RV 90/6 PA 90/35 PCWP 35 CI 1.6
- Placed on revatio and primacor with eventual decrease in PA pressures to 25/10 with PCWP of 10 and CI 2.5
- Consideration at this time of weaning inotropic support and inactivating him on OHT list

**DS**
- 55 yo WM with acute anterior wall MI Killip 4
- IABP placed at outlying hospital at the time of stenting to the LAD
- Pt transferred to TGH for evaluation of heart transplant secondary to ongoing hypotension and rising creatinine secondary to pump dysfunction and "low output" EF 15%
- My next question, what do the hemodynamics look like??
- The typical response: we don’t have a swan in him

**DS**
- Pt arrives at tgh on Levophed, IABP with multiple runs of NSVT on Amio drip
- Taken to the cath lab for rhc
- RA 2 PA 30/10 PCW 10 CI 3.0 SVR 600 BP 90/60
- IABP weaned over next few hours
- RA 5 PA 42/18 PCW 15 CI 2.5 SVR 1200 BP 110/60
- Levo weaned, vt abates so amio stopped
- Bp stabilizes and chf meds started pt eventually goes home on med rx and EF stabilizes about 30%
In Conclusion

- SG caths have a role in the evaluation of certain patient populations
- They have been given an unfair rap
- Important that the data is attained, appropriately understood, and that the catheters are removed as soon as able
- Hopefully in the not too distant future we will have implantable CHF monitoring that will non-invasively at the time of decompensation help guide therapy

*Thank you for your attention*
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