Summary of
Fiber-optic Technology

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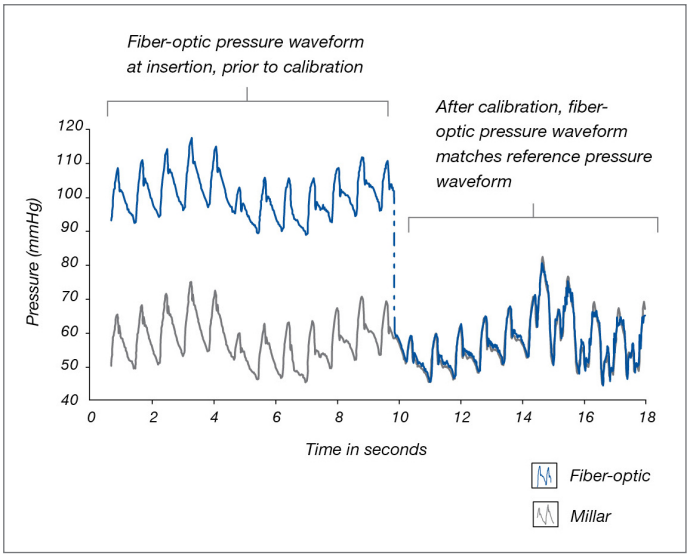
Fiber-optic technology compared to conventional fluid-filled catheter

- A conventional fluid-filled catheter remotely measures arterial pressure by means of fluidic pressure transduction through the catheter and an external pressure electrical transducer.[1] Accuracy is dependent on numerous factors which include: (1) calibration, (2) zeroing, (3) leveling, and (4) presence of air bubbles in the tubing. In addition, external effects such as patient movement and vibration encountered in ambulance or helicopter transport vehicles may further disturb the pressure signal.[1] Underdamping/resonance artifacts may alter blood pressure values in about one third of critically ill patients.[2]
- The inaccurate measurement of arterial blood pressure may cause inappropriate interventions such as a lack of fluids and/or vasoactive/inotropic support in true hypotension, or the treatment of false systolic hypertension, resulting in a reduction in tissue perfusion pressure. A difference >10 mmHg with actual arterial pressure is clinically relevant, and >20 mmHg is clinically unacceptable.[2]
- Fiber-optic pressure monitoring in intra-aortic balloon (IAB) therapy negates the inaccurate dynamic responses of fluid-filled transducers that result in measurement uncertainties and sub-optimal left ventricular support. The improved timing algorithms utilize the pressure information received 50 msecs faster than with fluid-filled transducers, measuring key markers on the pressure waveform and adjusting inflation and deflation accurately on a beat per beat basis. The option to automatically calibrate and recalibrate in vivo further improves the accuracy and monitoring of the fiber-optic technology. These advantages of fiber-optic over fluid-filled pressure monitoring resulted in our dual-center, prospective audit showing a 96% reduction in IAB related perfusion on-site call-outs (17 vs. 1) and a 94% reduction in sub-optimal timing (55/98 vs. 2/94). Fiber-optic IAB technology and improved algorithms provide better beat per beat mechanical support.[3]
- In situ pressure monitoring is definitely more accurate and safer than external pressure monitoring via fluid-filled catheters. The use of FOS (fiber-optic sensors) for IABP therapy should therefore provide a better control of triggering at the right time.[1]
- The economic impact of IAB catheter selection is harder to quantify than the clinical benefits. Consideration must be given to the ease of use, accuracy and decrease in the need for troubleshooting. Calls to physicians and perfusion can be frustrating and disruptive. Fiber-optic catheters can reduce the need for these calls.[3]
- Maquet has developed the only line of higher efficacy IAB catheters. The Sensation Plus® offers all the benefits of Maquet's easy-to-use IAB fiber-optic technology with the increased clinical effectiveness of larger volume IABs. "The net result of the larger-capacity IABPs is a significant reduction in cardiac filling pressures and augmentation in cardiac output. Based on our findings, the larger-capacity 50cc IABP may yield better clinical outcomes than the standard 40cc IABP in patients requiring temporary circulatory support."[5]



Maquet Fiber-optic IAB vs. Arrow FiberOptix™ Catheter

- The Maquet fiber-optic technology is the only fiber-optic catheter that utilizes automatic in vivo calibration. After insertion into the patient, the catheter automatically calibrates and then recalibrates every two hours or sooner should the patient or environmental conditions change. This results in faster time to therapy, ongoing consistency and accuracy of the arterial blood pressure waveform. In addition there is no need for the clinician to zero, level or adjust the pressures.
- The Maquet fiber-optic catheter extender tubing includes clips to secure the fiber-optic cable to the tubing minimizing the risk of damaging the fiber-optic cable.
- The Maquet intra-aortic balloon pump (IABP) uses the same timing algorithm for both fluid filled conventional catheters and the fiber-optic catheter for consistent and accurate timing.
- The Arrow fiber-optic catheter must be zeroed prior to catheter insertion and the following conditions must be present:
  - Fiber-optic sensor (FOS) connector and CAL key are connected
  - Data from CAL key has been downloaded to the IABP
  - No arterial pressure waveform is detected
  - The fiber optic electronics have reached the normal operating temperature[4]
- With the Arrow fiber-optic catheter there are some cases where it may not be possible to calibrate the FOS prior to insertion, resulting in inaccurate arterial pressure monitoring from the arterial pressure signal, similar to an unzeroed fluid-filled transducer. Since the FOS cannot be zeroed once the IAB is inserted into the patient, a method to adjust the arterial pressure values is available. The FOS calibration function allows the user to adjust the mean arterial pressure (MAP) value to another MAP value which is known to be accurate.[4]
- Once the IAB is inserted into the patient and connected to the IABP system, the fiber-optic cable should be taped to the driveline tubing in several places. There are no clips to assist in securing the cable to the helium tubing.[4]
- The Arrow WAVE algorithm only controls inflation timing when the fiber-optic signal is present. Because the timing of a fluid-filled pressure signal is based on historic data, arrhythmic episodes can lead to poor performance in patient support. In one example, the fluid-filled system properly timed inflation for only 4 out of 16 beats.[6]

References

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