

**Tabla 2** Análisis de los pacientes según la disfunción cardiaca izquierda moderada-grave

Variable	A n=9	B n=28	Odds ratio estimada 95% (CL)	p
Edad media (años)	43,2	57,3	0,928 (0,863-0,985)	0,01
Sexo			0,778 (0,104-4,634)	NS
♂	6	17		
♀	3	11		
Fumador (%)	0	35	0,159 (0-1,175)	NS
Alcoholismo (%)	11	10	1,041 (0,018-15,255)	NS
EPOC (%)	0	14	0,544 (0-0,620)	NS
Cirrosis hepática (%)	11	3	3,240 (0,038-274,492)	NS
Inmunodepresión	55	39	1,897 (0,326-11,892)	NS
Diabetes mellitus (%)	0	21	0,326 (0-2,597)	NS
Insuficiencia renal crónica (%)	0	10	0,774 (0-7,801)	NS
Infección(%)			1,194 (0,163-14,538)	NS
Grampositivo	25	28		
Gramnegativo	75	72		
APACHE II	27,8	23,1	1,098 (0,983-1,246)	NS
Mortalidad	55	42	1,644 (0,284-10,236)	NS

A: pacientes con depresión cardiaca moderada-severa; B: pacientes sin difunción cardiaca moderada-severa; CL: límites de confianza.

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## Transpulmonary thermodilution curve and the cross-talk phenomenon

### Curva de termodilución transpulmonar y el fenómeno cross-talk

The transpulmonary thermodilution (TPTD) operates via a single thermal indicator technique to determine cardiac index (CI), and derivatives volumetric variables.<sup>1</sup> The impact of shunt on CI and volumetric variables derived from TPTD curve has already been studied.<sup>2,3</sup> However, other TPTD signal artifacts have also already been evoked,<sup>4,5</sup> but their real impact on CI was never established.<sup>6</sup> The present case report describes the impact of a cross-talk phenomenon on the TPTD curve and CI measurement values when the technique was assessed using a femoral central venous access in a critically ill patient.

The IRB of Geneva University Hospitals determined that permission is not required for this report. However, permission to present the case was obtained from the patient. A previously healthy 19-year-old man was admitted to our hospital for the management of an acute ischemic stroke following a low-energy skiing accident. The patient initially developed diplopia and unsteady gait, rapidly followed by loss of consciousness. He was intubated on-site and taken to the emergency room. The cerebral CT-scan on admission showed a large hypodense lesion concerning both cerebellar hemispheres, predominantly on the right side, as well as a lesion of the left thalamus, consistent with ischemic stroke. There were signs of tonsillar engagement and compression of the fourth ventricle. Traumatic dissection of the right vertebral artery was suspected. An occipital craniectomy was urgently performed and an external ventricular drain inserted. Postoperatively the patient was transferred to the



**Figure 1** The transpulmonary thermodilution (TPTD) curve prior to draw back the right femoral PiCCO™ catheter. Please note that the TPTD curve is characterized by a premature as well as a late peak with a dilution appearing large and biphasic (CI value =  $1.15 \text{ Lmin}^{-1} \text{ m}^{-2}$ ).

intensive care unit for ongoing care. Forty-eight hours later a partial cerebellectomy was carried out in order to control elevation of intracranial pressure.

Since a vasopressor therapy with norepinephrine was intermittently necessary to maintain cerebral perfusion pressure and the patient presented a severe sepsis related to a sinusitis, we established an advanced hemodynamic monitoring using a TPTD curve technique (PiCCO™, Pulsion Medical Systems, Munich, Germany). A left femoral central venous catheter (ARROW international, 7F, 3 lumen, USA,) of 20 cm length was already in place since admission to avoid jugular or subclavian veins injuries and to optimize cerebral hemodynamics of a neurosurgical patient. Thus, we inserted a 20-cm-long PiCCO™ catheter (Pulsiocath; PiCCO™, Pulsion Medical Systems, Munich, Germany) in the right femoral artery using Seldinger's technique in order to complete the device setup (Fig. 1).

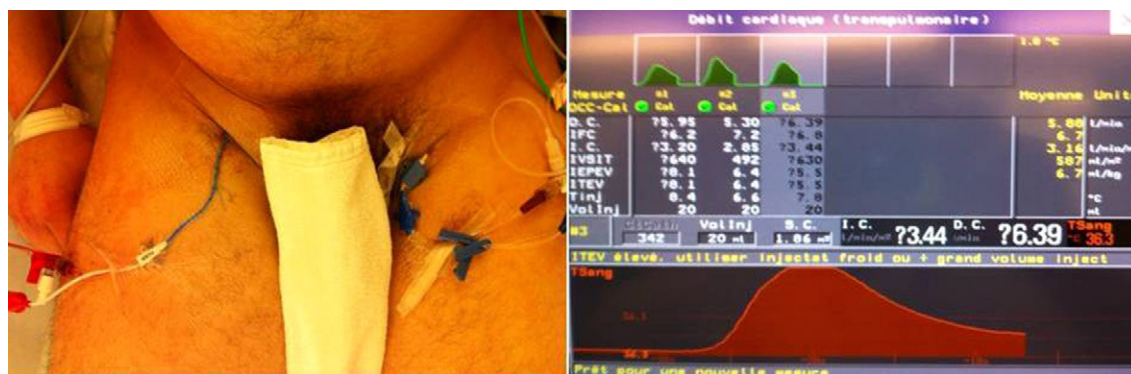
The thermodilution curves initially observed appeared early and biphasic ("camel-curve" type, Fig. 1), with an incomprehensibly low CI, when compared to the normal CI value obtained by echocardiography Doppler. Regarding the present situation, the requested attending physician assumed that the close and matched positioning of venous and arterial femoral catheters of equal length (20 cm) was responsible for the arising of a signal interference (known as cross-talk phenomenon). To resolve the present artifact, he asked the resident to draw back the

femoral PiCCO™ catheter by 8 cm (Fig. 2). Following this repositioning of the PiCCO™ catheter, we observed a common TPTD curve with normal uniphasic shape, signal delay and CI value (Fig. 2).

Venous-arterial thermodilution artifacts may be responsible for an early detection of the thermal indicator. As far as we know, this is the first observation of an early and biphasic "camel-curve" type, related to the anatomical contiguity of large vessels impacting CI values (Fig. 1).

The TPTD is a hemodynamic monitoring system gaining recognition and wide usage in the intensive care setting.<sup>7</sup> It operates via a single thermal indicator technique to determine extra vascular lung water, cardiac output, and volumetric variables. In our case, CI measurements were obtained after central venous injections of 20 ml of cooled (4°C) 0.9% saline via the femoral approach while the thermistor tip on the femoral artery catheter measured the downstream temperature change within the arterial system.<sup>8</sup> Cardiac output was then calculated by analysis of the temperature change of the TPTD curve using the Stewart-Hamilton method.

Schmidt and colleagues studied the effect of the femoral venous catheter site on TPTD variables and found that the TPTD curve obtained by a cold saline bolus provides clinically reliable CI and extravascular lung water index values.<sup>8</sup> In this interesting study the length of the venous catheters used was not provided in the article.<sup>5</sup> However, the authors ack-



**Figure 2** The transpulmonary thermodilution (TPTD) curve after the right femoral PiCCO™ catheter has been repositioned. Please note that the premature peak disappeared with a dilution appearing normal and less large (CI value =  $3.44 \text{ Lmin}^{-1} \text{ m}^{-2}$ ).

nowledged this limitation and affirmed that central venous catheters were longer (length of 30 cm) than the PiCCO™ arterial catheter (length of 20 cm) and all TPTD curves had a normal shape.<sup>9</sup>

In the present case, CI values were abnormally low before the right femoral PiCCO™ catheter was withdrawn by 8 cm (Figs. 1 and 2). This finding is rational as, in this setting; one part of the cold saline solution injected through the femoral venous catheter induced significant temperature changes in the close artery (vessels contiguity). This phenomenon produced a curve appearing large and biphasic shaped by a premature as well as a late peak. The time interval between the two peaks was necessarily longer than a right-to-left intracardiac shunt related to an atrial septal defect,<sup>2</sup> since the late peak represents the authentic blood transit time of the TPTD curve (Figs. 1 and 2). As the thermal bolus is detected twice (early artifact and expected detection) the area under the curve of TPTD curve was larger and consequently the CI lower. The detection of a common TPTD curve with CI values closely reflecting the patient cardiac function once the arterial catheter had been isolated from the injection site, clearly support our assumption.

In clinical practice, when treating neurosurgical critically ill patients, the use of a femoral central venous catheter is a secure approach as the present line position does not affect jugular venous return and potentially intracranial pressure. However, like in our case, the use of a femoral venous catheter longer than the femoral artery catheter is recommended to avoid a cross-talk phenomenon and its impact on CI values.

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## Supervivencia de la parada cardiorrespiratoria en relación con el área hospitalaria donde se detecta

### Survival in cardiopulmonary arrest according to the hospital area in which it is detected

A pesar de los elevados recursos tecnológicos y humanos hospitalarios, la mejora en la supervivencia de los pacientes que sufren una parada cardiorrespiratoria (PCR) en el hospital, tanto al alta como al año, no está mejorando de la misma forma que las acontecidas en el ámbito extrahospitalario<sup>1</sup>. Numerosas causas pueden explicar este hecho, como el origen extracardiaco de las PCR hospitalarias en la casi mitad de los casos, menor porcentaje de PCR por fibrilación ventricular, el representar en muchas ocasiones el final de enfermedades en situación terminal, etc.<sup>2</sup>. No obstante, un factor implicado, últimamente, en la baja tasa de recuperación vital y neurológica de la PCR hospitalaria ha sido las características del sistema de respuesta a la PCR. Así, se han publicado descensos en la mortalidad hospitalaria cuando

se producen cambios organizativos en su atención como la creación de planes hospitalarios, que incluyen un mejor acceso a los dispositivos de desfibrilación, y la introducción de equipos multidisciplinares de respuesta inmediata a la PCR<sup>3-5</sup>. En la actualidad nuestro hospital está inmerso en el desarrollo de un plan de mejora en la respuesta a la PCR, siguiendo las nuevas recomendaciones en soporte vital avanzado<sup>6</sup>. Con este fin, previamente, nos propusimos analizar la situación de la PCR intrahospitalaria, cuyos resultados exponemos.

Se analizó el conjunto mínimo básico de datos (CMBD), sistema que registra la información administrativa y clínica de los pacientes ingresados en los hospitales públicos españoles, de los años 2008-2009, de los hospitales General (592 camas) y de Rehabilitación y Traumatología (264 camas) del Hospital Universitario Virgen del Rocío de Sevilla. Se excluyeron los datos correspondientes a los hospitales Infantil y de la Mujer de dicho complejo. Asimismo, se excluyeron los pacientes con orden de no resucitación o cuya PCR se esperaba como acontecimiento final previsible de la enfermedad. Durante los dos años de estudio, el número de pacientes ingresados, incluyendo aquellos para cirugía