Solid Organ Donation and Transplantation Activity in the Eurotransplant Area During the First Year of COVID-19

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Background. Transplantation activity during the first wave of the coronavirus disease 2019 (COVID-19) pandemic was severely affected worldwide. This retrospective analysis aimed to assess the impact of COVID-19 on organ donations and transplantations in the Eurotransplant region during the first 12 mo of the pandemic. Specifically, we compared donor and transplantation numbers during both waves to determine whether transplant systems adapted to this new reality. **Methods.** All reported organ donations and transplantations from March 1, 2015, to February 28, 2021, were collected from the Eurotransplant International Foundation registry. The observation period from 2020 to 2021 was divided into three 4-mo periods, which were then compared with the corresponding periods of the preceding 5 y. COVID-19 cases for Eurotransplant countries were retrieved from the OurWorldInData.org database. **Results.** Overall, the number of organ donors decreased by 18.3% ($P<0.0001$) and the number of organ transplantations by 12.5% ($P>0.0001$) compared with previous years. Pancreas transplantation was the most affected, followed by kidney, liver, heart, and lung transplant. In detail, during period 1, the number of organ donors decreased by 26.2% ($P<0.0001$) and the number of organ transplantations by 16.5% ($P<0.0001$), in period 2 by 5.5% ($P<0.0091$) and 4.9% ($P<0.0001$), and in period 3 by 23.1% ($P<0.0001$) and 16.4% ($P<0.0001$), respectively. **Conclusions.** Organ donation and transplantation decreased drastically also during the second wave; however, despite the severity of the second wave, the decline was comparable with that of the first wave.

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INTRODUCTION

The first wave of the coronavirus disease 2019 (COVID-19) pandemic in spring 2020 severely impacted transplant activity worldwide.[1-6] Main reasons for the dramatic decline were the sudden and unforeseen lack of resources, on the one hand, and the lack of specific recommendations for maintaining transplantation activities during a pandemic, on the other hand. Concerns about potential donor-to-recipient transmission, screening strategies, posttransplant management, ethics and legal issues, and more caused great uncertainty and even led to a temporary suspension of nonvital transplants.[7,8]

The decrease in COVID-19 cases during summer 2020 reduced the burden on healthcare systems, and guidelines emerged that outlined how to maintain transplantation activity in case of a second wave.[3,6,9-11] Obviously, the question arises whether the experience gained during the first wave helped us to guide transplant activity better during the second wave. Unfortunately, the second (and third) wave in winter 2020 to 2021 lasted longer and was far more intense than the first wave, suggesting a negative influence on transplant activity.

This study aimed to illustrate the impact of COVID-19 on organ transplantation in the Eurotransplant (ET) region during the first 12 mo of the pandemic. The ET region comprises Austria, Belgium, Croatia, Germany, Hungary, Luxembourg, the Netherlands, and Slovenia and has a total population of around 137 million people. To determine whether transplant activity in ET countries adapted to this new reality, we analyzed the numbers of all organ donations and transplantations (ODTs) performed during the first 12 mo of the COVID-19 era and compared them with those of the previous 5 y.

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MATERIALS AND METHODS

ODT data for all ET countries from March 1, 2015, to February 28, 2021, were obtained from the Eurotransplant International Foundation registry. The data are public and anonymous, thus eliminating the need for approval by an ethics committee. For better differentiation of donor characteristics, organ donors were divided into living and deceased donors, and deceased donors were divided into donors after brain death and donors after circulatory death. Furthermore, reported kidneys were differentiated into living and deceased donations, whereas transplanted kidneys were distinguished into standard criteria donations and extended criteria donations. To allow for a more detailed description of ODT dynamics in the period from 2020 to 2021, we divided the observation period into three 4-mo periods, ranging from March 1 to June 30 (period 1), July 1 to October 30 (period 2), and November 1 to February 28 (period 3). Hence, period 1 represents the first wave of the COVID-19 pandemic, period 3 the second wave, and period 2 the interval in between them. ODT data for the period from 2020 to 2021 were then compared with those for the respective period of the previous 5 y. COVID-19 cases for ET countries were taken from the OurWorldInData.org database, which collects the worldwide COVID-19 figures on a daily basis. To objectify the magnitude of the 2 COVID-19 waves, the area under the curve was calculated for the respective course of confirmed new COVID-19 cases.

Statistical Analysis

Statistical analysis was conducted using R, version 4.0.3. A significance level of 5% was used for all assessments. Differences in the number of ODTs between the observation period from 2020 to 2021 and the corresponding periods in the previous 5 y are given as estimated mean differences with 95% confidence intervals and assessed with the Poisson test.

RESULTS

Organ Donation

During the observation period from 2020 to 2021, the total number of organ donors in the ET region decreased by 18.3% (2960 versus 3622; $P<0.0001$) compared with the average of the previous 5 y (Table 1). The number of living and deceased donors decreased by 32.1%

TABLE 1.

Number of organ donors, organs reported, organs transplanted, and patients on waiting lists during the first 12 mo of COVID-19 (defined as March 1, 2020, to February 28, 2021) compared with the mean values of the respective periods during the previous 5 y

	Count (2020–2021)	Mean count (2015–2019)	Decrease (%)	*P*
Donors reported				
Total	2960	3622 (3570-3676)	18.3	<0.0001
Living	957	1409 (1376-1442)	32.1	<0.0001
Deceased	2003	2214 (2173-2255)	9.5	<0.0001
DBD	1662	1881 (1843-1919)	11.6	<0.0001
DCD	341	333 (317-349)	–2.4	0.3388
Organs reported				
Heart	724	834 (809-860)	13.2	<0.0001
Lung	2000	2145 (2105-2186)	6.8	<0.0001
Liver	2089	2219 (2178-2260)	5.8	<0.0001
Pancreas	732	882 (857-909)	17.0	<0.0001
Kidney	4413	5367 (5303-5432)	17.8	<0.0001
Living	858	1315 (1284-1347)	34.8	<0.0001
Deceased	3555	4052 (3997-4108)	12.3	<0.0001
Organs transplanted				
Total	6160	7044 (6970-7118)	12.5	<0.0001
Heart	571	607 (585-629)	5.9	0.001
Lung	1257	1293 (1262-1325)	2.8	0.0228
Liver	1439	1620 (1585-1655)	11.2	<0.0001
Pancreas	152	203 (190-215)	25.0	<0.0001
Kidney	2741	3321 (3271-3372)	17.5	<0.0001
SCD	1583	1866 (1828-1904)	15.2	<0.0001
ECD	1158	1456 (1422-1489)	20.5	<0.0001
Waiting list				
Total	14260	14835 (14728-14942)	3.9	<0.0001
Heart	1108	1147 (1118-1177)	3.4	0.0091
Lung	623	767 (743-791)	18.7	<0.0001
Liver	1459	1661 (1626-1697)	12.2	<0.0001
Pancreas	397	433 (415-452)	8.3	0.0001
Kidney	10673	10827 (10736-10919)	1.4	0.0009

Data are presented as mean (95% CI).

CI, confidence interval; COVID-19, coronavirus disease 2019; DBD, donation after brain death; DCD, donation after circulatory death; ECD, extended criteria donation; SCD, standard criteria donation.

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TABLE 2.

Number of organ donors, organs reported, and organs transplanted during the observation periods 1–3 during 2020–2021 compared with the average numbers of the corresponding periods of the previous 5 y

	Period 1				Period 2				Period 3			
	Count (2020–2021)	Mean count (2015–2019)[a]	Decrease (%)	*P*	Count (2020–2021)	Mean count (2015–2019)[a]	Decrease (%)	*P*	Count (2020–2021)	Mean count (2015–2019)	Decrease (%)	*P*
Donors reported												
Total	881	1193 (1163-1224)	26.2	<0.0001	1130	451 (433-470)	5.5	0.0091	949	1234 (1203-1265)	23.1	<0.0001
Living	243	478 (459-497)	49.1	<0.0001	406	451 (433-470)	10.0	<0.0001	308	480 (461-499)	35.8	<0.0001
Deceased	638	715 (692-739)	10.8	<0.0001	724	745 (721-769)	2.8	0.0869	641	754 (730-778)	15.0	<0.0001
DBD	544	609 (587- 631)	10.6	<0.0001	590	632 (610-654)	6.7	0.0001	528	640 (618-662)	17.5	<0.0001
DCD	94	106 (98-116)	11.7	0.0049	134	113 (103-122)	–19.0	<0.0001	113	114 (105-124)	0.9	0.8334
Organs reported												
Heart	237	273 (259-288)	13.3	<0.0001	261	280 (266-295)	6.9	0.0085	226	281 (266-296)	19.5	<0.0001
Lung	634	699 (676-723)	9.3	<0.0001	710	731 (707-755)	2.8	0.0839	656	715 (692-739)	8.3	<0.0001
Liver	664	713 (690-737)	6.9	<0.0001	757	744 (721-769)	–1.7	0.3097	668	761 (737-786)	12.2	<0.0001
Pancreas	216	290 (275-305)	25.4	<0.0001	276	296 (282-312)	6.9	0.0065	240	296 (282-312)	19.0	<0.0001
Kidney	1327	1759 (1723-1797)	24.6	<0.0001	1695	1782 (1745-1819)	4.9	<0.0001	1391	1826 (1789-1864)	23.8	<0.0001
Living	207	446 (427-465)	53.6	<0.0001	375	421 (404-440)	11.0	<0.0001	276	448 (430-467)	38.4	<0.0001
Deceased	1120	1314 (1282-1346)	14.7	<0.0001	1320	1361 (1328-1393)	3.0	0.0129	1115	1378 (1346-1411)	19.1	<0.0001
Organs transplanted												
Total	1923	2304 (2262-2346)	16.5	<0.0001	2266	2381 (2339-2425)	4.9	<0.0001	1971	2358 (2316-2401)	16.4	<0.0001
Heart	191	197 (185-210)	3.1	0.3316	202	206 (193-219)	1.8	0.5711	178	204 (192-217)	12.8	<0.0001
Lung	369	436 (418-455)	15.4	<0.0001	469	442 (424-461)	–6.2	0.0048	419	415 (397-433)	–1.0	0.6701
Liver	462	527 (507-548)	12.3	<0.0001	512	545 (525-566)	6.1	0.0011	465	548 (572-569)	15.1	<0.0001
Pancreas	50	70 (63-78)	28.8	<0.0001	66	69 (62-76)	3.8	0.4741	36	64 (57-71)	43.6	<0.0001
Kidney	851	1073 (1045-1102)	20.7	<0.0001	1017	1120 (1091-1150)	9.2	<0.0001	873	1128 (1099-1158)	22.6	<0.0001
SCD	505	611 (590-633)	17.4	<0.0001	609	651 (629-674)	6.5	0.0002	469	603 (582-625)	22.3	<0.0001
ECD	346	462 (443-481)	25.1	<0.0001	408	469 (450-488)	13.0	<0.0001	404	525 (505-545)	23.0	<0.0001

[a]Data are presented as mean (95% CI).

CI, confidence interval; DBD, donation after brain death; DCD, donation after circulatory death; ECD, extended criteria donation; SCD, standard criteria donation.

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(957 versus 1409; $P<0.0001$) and 9.5% (2003 versus 2214; $P<0.0001$), respectively. The number of donation after brain death donors decreased by 11.6% (1662 versus 1881; $P<0.0001$), whereas the number of donation after circulatory death donors remained unchanged (341 versus 333; $P=0.3388$; Table 1). The decline in organ donors is reflected in a decrease in the number of all organs reported in the ET area, including hearts, lungs, livers, pancreas, and kidneys (all $P<0.0001$; Table 1). With respect to kidney grafts, donations from living and deceased donors decreased by 34.8% (858 versus 1315; $P<0.0001$) and 12.3% (3555 versus 4052; $P<0.0001$), respectively.

The mean number of actively listed patients waiting for a heart, lung, liver, pancreas, and kidney transplantation significantly decreased during the first 12 mo of the pandemic compared with the previous 5 y (Table 1).

Organ Transplantation

The number of transplantations performed decreased significantly for all organ entities in the ET region, with abdominal organs being more affected than thoracic organs (Table 1). No single ET country was able to prevent a decline in the total number of organ transplantations (all $P<0.001$); however, stable rates for heart transplantation could be maintained in Austria (minus 8.7%; $P=0.103$), the Netherlands (minus 3.0%; $P=0.6673$), and Slovenia (minus 14.7%; $P=0.0774$); stable rates for lung transplantation in Germany (minus 0.5%; $P=0.7764$), Hungary (plus 16.6%; $P=0.0501$), and the Netherlands (plus 3.7%; $P=0.3087$); stable rates for liver transplantation in Austria (minus 5.9%; $P=0.0897$) and the Netherlands (minus 4.3%; $P=0.2101$); and stable rates for pancreas transplantation in Germany (minus 6.3%; $P=0.1619$) and Hungary (minus 9.1%; $P=0.5828$). Kidney transplantations decreased significantly in all countries (all <0.05). Standard criteria donation and extended criteria donation kidney transplantations decreased by 15.2% (1583 versus 1866; $P<0.0001$) and 20.5% (1158 versus 1456; $P<0.0001$), respectively (Table 1).

Temporal Analysis

The total number of organ donors decreased by 26.2% in period 1, by 5.5% in period 2, and by 23.1% in period 3 (all $P<0.0001$) compared with the mean number of the corresponding periods of the preceding 5 y (Table 2). As a result, the number of performed transplantations decreased by 16.5% in period 1, by 4.9% in period 2, and by 16.4% in period 3 (all $P<0.0001$). Details on the temporal development of the ODT numbers during the observation period are presented in Table 2. A graphical presentation of ODT numbers in relation to cumulative COVID-19 cases in the ET countries is shown in Figure 1. Calculation of the area under the curve of cumulative COVID-19 cases found that the magnitude of the second COVID-19 wave was 12-fold higher than that of the first wave (Figure 1).

DISCUSSION

This retrospective analysis shows that the first 12 mo of the COVID-19 pandemic caused a significant drop in organ donation and transplantation activities in the ET region, with all ET countries being similarly affected. The decrease in ODTs during the second wave was comparable with that during the first one, although the incidence of COVID-19 cases was unequally higher during the second wave.

Limited knowledge of the new infectious disease caused by severe acute respiratory syndrome coronavirus 2, the unknown impact of infection in immunosuppressed organ recipients, and possible severe acute respiratory syndrome coronavirus 2 donor-to-recipient transmission moved several transplantation societies to the recommended postponement of nonurgent kidney and pancreas transplantations in March 2020.[7] As the rapid progression of the pandemic demanded that substantial healthcare resources be made available quickly,[12] many surgical intensive care units (ICUs) were converted to COVID-19 ICU facilities, and medical staff was relocated to prevent critical healthcare areas from collapse.[7] These measures most likely caused an additional reduction in ODTs during the first trimester of our observation period compared with the previous 5 y, which is in line with reports from various countries describing a similar development during the first wave (spring 2020) of the COVID-19 crisis.[1,2,4,7,13-15] In addition, societal and habitual changes during lockdown periods may have contributed to the decrease in potential organ donors. One example could be the decrease in the

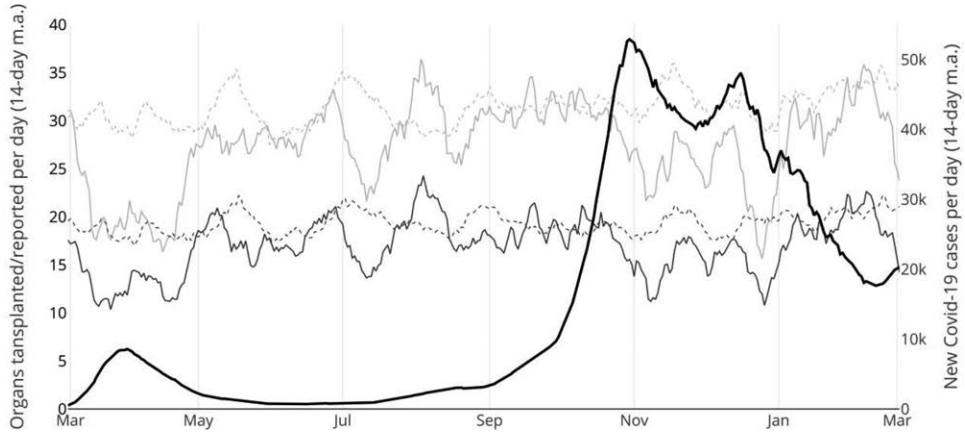

FIGURE 1. The light gray and dark gray lines (solid for the period 2020–2021 and dashed for the period 2015–2019 averages) represent organs reported and organs transplanted, respectively. The solid black line represents the 14-d moving average of daily new COVID-19 cases in the Eurotransplant region. COVID-19, coronavirus disease 2019.

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number of traumatic brain injuries because of falls and road traffic accidents.[16]

As the numbers of COVID-19–infected patients began to decline toward the end of spring and early summer 2020, transplant activities in the ET region recovered slightly, although they remained below the level of the previous 5 y. With the emergence of the second wave by the end of summer 2020 (third period in our observation), ODT activities again significantly declined, comparable with period 1. This finding cannot be attributed to recommendations to postpone organ transplantations but probably reflects the need to again convert surgical units and ICUs to COVID-19 units. Although it may seem that our experience from the first wave was of little help in sustaining ODT activity during the second wave, it is important to acknowledge that the daily incidence of COVID-19 infections was disproportionately higher in winter 2020 to 2021 than in spring 2020 (Figure 1). The fact that ODT activity remained comparable suggests that efforts to maintain transplant volume during the second wave of the pandemic were partially successful. These include, for example, coordinated interdisciplinary management of surgical volume and intensive care capacity.[15] Also, the increasing availability of tests and protective equipment may have contributed to the stabilization of ODT activity in the third trimester.

In conclusion, despite the lessons learned from the first wave and the significant efforts made during the second wave to stabilize transplant activity, the number of ODTs dramatically decreased also during the second wave compared with the same period in previous years; however, it must be emphasized that, despite the severity of the second COVID-19 wave, the decline was not greater than that of the first wave.

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